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GLOBAL WARMING AND CAFE STANDARDS

HEARING

BEFORE THE

SUBCOMMITTEE ON THE CONSUMER

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

FIRST SESSION

ON

GLOBAL WARMING AND CORPORATE AVERAGE FUEL ECONOMY (CAFE) STANDARDS

MAY 2, 1989

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GLOBAL WARMING AND CORPORATE AVERAGE FUEL ECONOMY STANDARDS

TUESDAY, MAY 2, 1989

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
SUBCOMMITTEE ON THE CONSUMER,
Washington, DC.

The subcommittee met, at 9:37 a.m., in room SR-253, Russell Senate Office Building, Hon. Richard H. Bryan (chairman of the subcommittee) presiding.

Staff members assigned to this hearing: Linda Lance; Kevin Curtin, staff counsels; and Alan Maness, minority staff counsel.

OPENING STATEMENT BY SENATOR BRYAN

Senator **BRYAN**. Good morning.

We are here today to explore the important and I must say complex issue of vehicle fuel economy standards. Current law passed in 1975, with the assistance of Commerce Committee Chairman Hollings, set standards which were increased gradually between 1978 and 1985 and resulted in doubling of new car fuel economy during that period of time.

Those standards have saved untold billions of gallons of fuel. In fact, it has been estimated that today we would be consuming 2.5 million gallons—2.5 million barrels a day more of oil, at a cost of $40 billion to the American public.

The increases in fuel economy achieved by the automobile industry in response to those standards should be a source of great pride to all who have been involved. However, today we have almost daily reminders of the continued need to conserve energy.

We are importing an increasing amount of oil, and it is estimated that imports may rise to 50 percent of consumption in just a few years. The tragic oil spill in Alaska is one graphic reminder of the non-economic price we pay for the use of oil.

Increased emissions of carbon dioxide, a primary greenhouse gas, which are caused in part by the burning of fossil fuels, present an undetermined level of threat to the climate and to the environment of the world as we know it today.

We know that fuel economy is an efficient method of reducing carbon dioxide emissions. The Department of Transportation has estimated, in connection with petitions to reduce CAFE standards for the years 1989 and 1990 model years, that a rollback of the standards by just one mile per gallon for those model years will result in increased emission of 18 million tons of CO_2 over the lifetime of those vehicles.

The transportation sector also is high on the list of energy consumers, accounting for 66 percent of U.S. petroleum use and 31 percent of all carbon dioxide emissions.

However, despite the urgent need to conserve energy, vehicle fuel economy has at best reached a plateau, and in some cases begun a decline. It is argued that the marketplace provides little incentives for consumers to make fuel efficiency a priority in their choice of vehicles. Manufacturers say that they have little incentive to put fuel economy at the top of their list of design or marketing priorities.

Indeed, we are seeing an increasing emphasis on larger and higher performance vehicles, including low mileage light trucks and vans.

Thus, it is clear that the Congress is faced with difficult choices in attempting to address the serious risks represented by environmental and energy security trends. I do not think it is an overstatement to say that we also are presented with an exciting opportunity to sift through the possibilities and make a real contribution to the future of our country and of our world.

As part of that effort, we will hear from a wide range of experts on the issue of fuel economy standards this morning. Our first witness will be our colleague Senator Metzenbaum, who has a longstanding interest in this issue and has begun work again in this Congress.

We also are fortunate to have a witness from the Office of Technology Assessment, which has been doing extensive and thorough scientific analysis in this area and is an important resource for the Congress.

Several agencies bring their expertise to bear on this problem, and today the Departments of Energy and Transportation and the Environmental Protection Agency will give us the benefit of their expertise.

Ford, GM, and Chrysler are also with us today. I am hopeful that this will begin a constructive dialogue between the industry and all others working on this issue to craft a responsible and sensible policy in this area. Needless to say, the industry's knowledge is important to the policymaking process.

I should note that representatives of foreign car manufacturers were invited to join us today and, although they were unable to do so, I am hopeful that we will hear from them in the future. Their views are an important part of the total picture.

Finally, we will hear from three interest groups that have been doing valuable work on fuel economy. They are well qualified to address the environmental consequences, technological capability, market forces, and auto safety consequences of various policy choices presented to the Congress.

We welcome you all here. We appreciate your time and effort, and we look forward to our productive work together.

We will also hear this morning from other members of the committee who might care to offer an opening statement. I believe Senator Gore arrived first this morning and has had a long interest in this, if you would care to make an opening statement, Senator.

All right. The Senator indicates he will defer to the ranking member, Senator Gorton.

Slade.

OPENING STATEMENT BY SENATOR GORTON

Senator GORTON. Thank you, Mr. Chairman.

The recent oil spill in Prince William Sound in Alaska reminds us of at least two features of our energy policy, and certainly is related to the hearing which we are having here today.

First, of course, the exploration for and the production of and the use of all forms of energy involves serious environmental tradeoffs. We are going to hear a great deal today, thanks to your calling this hearing, Mr. Chairman, on the relationship between these standards and the ultimate environmental challenge, the projected warming of the Earth which would represent perhaps the greatest single climatic change since the last Ice Age.

Over and above and beyond that, of course, are the kind of environmental challenges which are posed by exploration for oil, by its transportation, and the other vitally important environmental impacts of what we do.

But there is a second point to these standards and to these hearings, and that is the cost of energy, the impact of the use of imported energy sources on our balance of payments, the impact of our dependence on those foreign energy sources for our own security.

These standards since they were first imposed have had the tremendously positive impacts which you have already outlined in your opening statement. I for one am disturbed that we have flattened out in our effort to increase those standards and to work toward a greater degree of both energy independence, a lessening dependence on foreign oil, and environmental improvement.

I believe that our first witness, who has now arrived, is to be commended for the attempts which he has made consistently to drive forward this most important priority. I am looking forward to hearing from him and the long list of witnesses that we will have in front of us today.

Senator BRYAN. Thank you very much, Senator Gorton.

Senator GORE.

OPENING STATEMENT BY SENATOR GORE

Senator GORE. Thank you very much, Mr. Chairman. I want to compliment you on the way you have taken charge of this subcommittee and really moved it forward quickly and scheduled this hearing, which is such an important hearing on such a critical issue, early in the Congress.

As has been noted, Mr. Chairman, by you and by Senator Gorton, the worst oil spill in our nation's history happened only five weeks ago, and to date only one percent of the 1,000 miles of oil-saturated coastline have been cleaned up. It is also important to note that, if that oil spill had not taken place and the tanker had not hit the reef, the oil would have been processed and unloaded into incredibly inefficient cars and trucks and been spilled in a different form into the air of our cities and the atmosphere of our Earth.

It is time for us to become better stewards of the Earth's environment. We have heard appropriate calls for global cooperation to protect the world's environment, but that protection must begin here at home with policies that we in this United States Senate have an opportunity to change, because our cars and trucks are responsible for much of the air pollution choking our cities and a large portion of the carbon dioxide emissions that our nation is contributing to the rest of the world, to the entire world.

And so one of the first steps to demonstrate U.S. leadership in protecting the global environment must be to increase the efficiency of our transportation sector. Americans consume more energy for transportation alone than individuals in almost every other country consume in every part of their lives.

We do not need to speed development of environmentally sensitive areas to produce more oil for our vehicles. We can produce that extra oil in a real sense through increased vehicle fuel efficiency.

As the Chairman has noted, after dramatic improvements in the seventies, we marked time in the eighties, and vehicle efficiency in 1988 was actually lower than the standards set for 1985.

Clearly, improvements in fuel efficiency are long overdue, and they make sense for a variety of reasons. Oil imports cost our trade balance $40 billion in 1988. For every one mile per gallon increase in car and light truck fleet efficiency, we could reduce oil imports by 320,000 barrels per day, and even at only twelve dollars per barrel that is $1.5 billion off our trade deficit each year. So one mile per gallon improved efficiency translates into $1.5 billion less in the trade deficit each year.

Secondly, of course, our national security continues to be threatened by an overreliance on oil imports.

Third, our competitiveness in international markets is compromised by energy inefficient products.

Next, our vehicle fleet contributes as much as one-third of U.S. carbon dioxide emissions overall.

And last but not least, urban air quality in many cities is not coming into compliance with standards deemed necessary to avoid adverse impacts on the health of our children and ourselves.

Among the major pollutants addressed by the Clean Air Act, the two that have proven most difficult to control, carbon monoxide and low level ozone, are largely due to our automobiles.

On the first day of this 101st Congress, I introduced legislation calling for new vehicle efficiency standards as part of a Comprehensive World Environment Policy Act designed to address many of the sources of the global environmental crisis.

As a member of this subcommittee with jurisdiction over this issue and as a member of the Commerce Committee which will address this issue this year, I want to serve notice that I intend to assign the highest priority to this aspect of what we can do to solve the global environmental crisis.

Thank you, Mr. Chairman.

Senator **BRYAN**. Thank you very much, Senator Gore.

Senator Kasten.

OPENING STATEMENT BY SENATOR KASTEN

Senator **Kasten**. Mr. Chairman, thank you.

I have got a statement which I would like to submit for the record.

But I would just like to make one point if I could. I think that it is interesting, when we look back we see that the CAFE concept was originally enacted in 1975, which was in the aftermath of the Arab oil embargo, the impact of the Arab oil embargo on the U.S. economy and on the world.

The primary impetus of this legislation at that time, was the reduction of U.S. dependence on foreign oil. Here we are today 14 years later and, as the title of this hearing indicated and I think as the packed audience indicates, we are now talking as much about the environmental concern about global warming as we are about energy independence.

I think that is important and I think it is significant. And Mr. Chairman, I think that is why these hearings today are so important.

Mr. Chairman, I look forward to today's hearing on the CAFE standard. The CAFE concept was originally enacted in 1975, in the aftermath of the severe impact of the Arab oil embargo on the economy of the U.S. and the world. At that time the primary impetus for this legislation was the reduction of U.S. dependence on foreign oil. Fourteen years later, as the title of today's hearing indicates, the debate on the CAFE standard centers as much around the environmental concern about global warming as energy independence. I know that you, Mr. Chairman, along with Senator Hollings, Senator Gore, and others, are sponsors of global warming legislation which would significantly increase the CAFE standard by the year 2000.

In the past I have expressed my concerns about CAFE and the effects that this type of regulation might have on American jobs in the auto industry, the choice of American consumers as to the size and types of cars they demand, and the cost to the industry, and thus the public, of meeting the standards. The goal of improved fuel efficiency is not questioned by anyone, rather the debate centers around the method to promote this goal and the practicality of the actual CAFE standards set.

I continue to have some reservations on CAFE. However, we have made significant improvements in the fuel efficiency of the U.S. fleet, and I do believe that some of this has been due to the existence of some standards.

With the developments that we have seen with OPEC getting its act together, and given the fact that we are dealing with a limited resources that at present is the only reasonable fuel for transportation uses, I am concerned that the U.S. manufacturers are working as hard as they must to assure that our products will be acceptable in tomorrow's marketplace and tomorrow's world. Whether the establishment of higher CAFE standards is what is needed to assure continued development in this area what we shall hear debated today, and during this Congress.

The numbers are scary. According to EPA, automobile usage itself accounts for 12 percent of the greenhouse effect. But we must remember that the environmental question is a global concern, and must be addressed by global cooperation. From an oil independence standpoint, transportation accounts for 60 percent of oil consumed. Surely this is an area for government attention, and hopefully public/private sector cooperation in formulating policy to protect our environment and our various national interests. I look foward to hearing from our witnesses today and working with the members of this subcommittee on the CAFE issue.

Senator **Bryan**. Thank you very much, Senator Kasten, for your comments.

I have a statement that the Chairman, Senator Hollings would like to have included in the record.

[The statement follows:]

OPENING STATEMENT BY THE CHAIRMAN

I am pleased to see the Commerce Committee continuing its work on fuel economy standards. In 1975, I cosponsored the legislation that became the current CAFE law. In looking back at the record of the committee's work on the issue in 1975, I realize that several things I said at the 1975 hearing bear repeating today.

I noted then that the automobile has been a dominant influence in 20th century America, shaping our economy and our way of life, and it is now a necessity for most Americans. However, then, as now, the automobile also is a major contributor to air pollution and resource depletion.

The one major change since 1975 is the dramatic increase—an approximate doubling—of the fuel efficiency of the new car fleet. This fact makes me very proud of the work we did to enact the CAFE law in 1975. It makes me very proud of the ingenuity of the automobile industry—a vital component of our economy. It also makes me think that we must continue to look at CAFE standards as at least a partial answer to the serious problems presented by the country's reliance on imported oil and the threat of global warming.

President Reagan reported to the Congress in January of this year that the current level of oil imports presents a threat to our national security. In addition, experts from many disciplines warn us that we must pay immediate attention to the long-term effect of greenhouse gases on the Earth's climate. Increased energy efficiency can address both those problems.

I have introduced a bill, which the Commerce Committee has ordered reported, to coordinate and advance the research on global warming, and energy policy is certainly a part of that research. I have written to DOT Secretary Skinner, urging him to retain the 1990 CAFE standards at 27.5 miles per gallon. Both of these steps are improtant in addressing the dual problems of energy security and the environment.

For the future, it is clear that we must continue to work hard toward increased fuel economy. Now, as in 1975, there is increased consumer demand for large cars with higher performance. Now, as then, it may be difficult to achieve significant increases in fuel economy through market forces or voluntary activities by the auto companies.

However, we all recognize that the auto industry is an important contributor to the United States and world economies. We want to work with, not against, the members of that industry in addressing our environmental and energy security concerns. We also want to protect the right of the American consumer to a reasonable choice of products.

Thus, many important, and sometimes competing, factors need to be considered in the vital effort to conserve energy. We have witnesses here today who can tell us about those competing factors, and, I hope, suggest ways to accommodate them. I look forward to the testimony, and to continuing the work on fuel economy we began in 1975.

Senator **Bryan**. Indicative of the interest that this hearing has generated this morning, we are delighted to have Senator Breaux join us as well.

And our colleague Senator Metzenbaum will be our first witness this morning. Senator, Good morning.

STATEMENT OF HON. HOWARD M. METZENBAUM, U.S. SENATOR FROM OHIO

Senator METZENBAUM. Good morning. It is good to be here.

Thank you, Mr. Chairman. Let me say how pleased I am to be here this morning, at the timing of it, the fact that you have seen fit to call it, and the fact that you have an excellent turnout of members who have indicated strong interest, as they have in the past in their legislative careers.

I would be remiss if I did not say how particularly pleased I am to see Al Gore back at this committee hearing. We are glad that your son is doing well enough that you are back with us, and we wish him continued improvements.

Senator GORE. Thank you, Howard. I appreciate it.

Senator METZENBAUM. I think that holding these hearings is both timely and important, and there is no secret about it, and I appreciate the comment of my friend Slade Gorton, that for a long period of time I have believed that we need to strengthen the CAFE standards, and I believe 1989 is the year to accomplish that goal.

In passing EPCA, the Energy Policy and Conservation Act, Congress told auto companies to double the average fuel economy of their new car fleet in a decade's time. The automakers protested that this was virtually impossible. I recall that Lee Iacocca said that if we passed CAFE everyone would have to be driving Pintos in 1985.

Parenthetically, it is interesting to note that at the time when the issue of the rollback occurred, Lee Iacocca did not ask for the rollback. The other two major automobile manufacturers did. Unfortunately, they prevailed.

The automakers obviously were dead wrong. 1985 came and went and the auto driving public was not stuck in Pintos, thank heavens.

Despite the companies' protests, technical ingenuity carried the day, bringing us widespread use of fuel injection, lighter materials, better aerodynamics, front wheel drive, and a host of other improvements. Rather than driving smaller cars, the American public is driving better performing and more fuel efficient cars of all sizes.

Since EPCA was passed, fuel efficiency doubled, while average interior volume of cars has remained virtually constant and average horsepower has actually jumped by 20 percent.

Two weeks ago I chaired hearings on CAFE before the Energy Regulation and Conservation Subcommittee, and I did that because the issue had been raised, we talked about it, with an amendment that I had to the Arctic National Wildlife Refuge bill. Do not ask me why those two are connected because I am not certain.

But suffice it to say that the committee by a vote of nine to nine defeated my amendment, and one member of the committee indicated he would have voted for it except he felt that jurisdiction belonged here. And I have never had any question about that the jurisdiction does belong here.

But during those hearings that we had, we heard the same protests from the auto companies that we have been hearing all along:

Tighter CAFE standards cannot be accomplished without severely limiting their output of certain large cars.

Just as they did in the seventies, they neglected the role of technology in meeting a reasonable CAFE standard. There have been several independent analyses performed as to how far the automakers can boost fuel efficiency without losing interior space or horsepower.

Studies by the Department of Energy and the Office of Technology Assessment determined that a CAFE of 33 to 35 miles per gallon by 1995 would be practical and cost effective and does not require a shift in size, mix, or performance.

By the time you leave this room today, I would guess that you will become as convinced as I am of the practicality and necessity of what I call the no-sacrifice CAFE, a schedule for improvements in auto fuel efficiency that can be met strictly by deploying familiar, off the shelf technologies throughout the fleet, technologies as commonplace as four-valve engines and four-speed automatic transmissions.

Shortly I will introduce the Automobile Fuel Economy Act of 1989 to make the no-sacrifice CAFE the law of the land. Now, that legislation will set up a schedule for slowly increasing CAFE standards. By the year 2000, according to the Energy Information Administration, such an increase could save probably 400,000 to 600,000 barrels per day.

Secondly, the legislation would establish a no-backsliding provision. The CAFE's of several automakers, primarily the Japanese, as they strive to corral our high-end auto market, have been steadily declining over the last several years, and this provision would put a quick stop to that practice of backsliding, going back and claiming the credits from yesteryear.

Additionally, the no-backsliding requirement would prevent domestic automakers from moving the production of larger cars overseas and the many thousands of jobs associated with that movement, since it would prevent backsliding with respect to their imported sub-fleets, which now average about 40 miles per gallon.

Thirdly, the legislation would increase the penalties for noncompliance with CAFE from the current five dollars per tenth mile to 10 dollars per tenth, and the bill would give the Secretary of Transportation the authority to increase the penalty up to $20 per tenth for auto companies that display a continuing pattern of noncompliance.

Now, let me address that matter of noncompliance by some companies that frankly do not give a damn, companies such as Mercedes and Jaguar and Rolls-Royce, who disregard the standards year after year and know that the price will just be added on. But it is such a small item in a $55,000 or $75,000 or $100,000 car that nobody pays much attention.

I remember early on when I had legislation on that issue of CAFE and we were moving on the subject, and I remember getting a call from the British embassy asking on behalf of Rolls-Royce that they be exempted from the CAFE standards. And I could not think of anything more ludicrous than to suggest that the most expensive car being driven on the streets of America at that time, probably even today, would be exempt and that we would have some special category for those people who own Rolls-Royces and would not have to conform with the laws of this land.

Frankly, obviously that did not occur. But I believe that the Secretary or this committee should be giving consideration to going even further than five dollars to $20 per tenth. I do not think that is enough for some of these cars.

I think that there ought to be included in the legislation a concept that if a company consistently and regularly indicates that they are not going to conform with these standards and are just going to pay the penalty, then in some manner that company's cars would totally be banned from the streets of America, because it does not make any difference if you add $20 a tenth of a mile to somebody buying a Rolls-Royce.

What difference does it make if they pay $105,000 or $108,000 or $110,000? It could not matter at all to them.

But if those companies are not going to conform with our concepts and our thrust of our concerns, then I think perhaps those cars should be banned from the streets of America.

Finally, the bill would authorize several formal studies regarding automotive technologies, fuel economy testing procedures, and alternative approaches to fuel economy standards.

I believe it is critical to pass CAFE legislation as soon as possible. I hope this committee will move promptly and not delay action on this. It is essential to re-establish the policy first put into place by EPCA, and that is that the efficient use of oil is an important goal of the United States.

My legislation will move in that direction, and I commend the chairman of this committee for holding this timely hearing on CAFE. I encourage him to mark up CAFE legislation, whosoever it might be, at the earliest possible opportunity.

I say to you, I offer my strong support in this endeavor and look forward to working with you and the other members of the committee in moving forward to do something about a problem about which we can do something and should be doing it as soon as possible. We probably should have done it yesterday.

Thank you, Mr. Chairman.

Senator **Bryan**. Senator Metzenbaum, we appreciate your testimony and your observations this morning. Are there any questions of the Senator by any of the members of the committee?

Senator **Gore**. Mr. Chairman.

Senator **Bryan**. Senator Gore.

Senator **Gore**. Let me just say briefly that I personally appreciate the leadership Senator Metzenbaum has provided on this issue, and I appreciate your personal words at the beginning of your testimony. And indeed, the day after the tragedy our family encountered was the day that you had asked me to be the first witness at the hearing that you referred to.

And I have been looking forward to working with you very closely on this issue. We see this issue in very similar terms. and frankly you have been bringing the fire and determination to this cause for a long time, and I just wanted to commend your efforts.

I know it has been a hard battle and there are some tough opponents. But I think the political environment is changing and I think we are going to see some movement on this issue.

Senator **Metzenbaum**. Thank you very much, Senator Gore.

Senator **Bryan**. Thank you again, Senator.

Senator **Metzenbaum**. Thank you, Senator. Thank you.

Senator **Bryan**. Our first panel this morning will include: Mr. Steve Plotkin, who is a Senior Associate, Energy and Materials Program, Office of Technology Assessment; Mr. Barry Felrice, the Associate Administrator for Rulemaking, National Highway Traffic Safety Administration; Dr. John Berg, the Assistant Secretary for Conservation and Renewable Energy, the Department of Energy; and Mr. Richard D. Morganstern, Director, Office of Policy Analysis, Environmental Protection Agency.

Gentlemen, welcome, and we will begin with Mr. Plotkin.

STATEMENT OF STEVE PLOTKIN, SENIOR ASSOCIATE, ENERGY AND MATERIALS PROGRAM, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. **Plotkin**. Mr. Chairman and members of the subcommittee, thank you for inviting OTA here to discuss our recent work on the fuel efficiency of the U.S. light duty fleet of automobiles and light trucks.

Mr. Chairman, at a time when U.S. oil imports are rising and seem likely to continue to rise over the next decade, when concerns about global warming point to a strong general need to promote energy conservation in all sectors of the economy, when the demand for travel in light duty vehicles, which already accounts for 39 percent of U.S. oil use and 16 percent of total U.S. energy consumption, is rising steadily and shows no signs of slowing down significantly, Congress is rightly concerned about the recent slowdown in improving the fuel efficiency of new light duty vehicles and the poor prognosis for future improvements.

There are several reasons why improvements in new vehicle fuel economy are slowing. These begin with the lack of market interest. Surveys show a large falloff in consumer interest in fuel economy. In 1980 one in three car buyers listed fuel economy as their number one concern in buying a new car. By 1987, three percent still felt that way.

Past progress in efficiency, coupled with lower gasoline prices, have driven down gasoline costs to only 15 cents of every dollar spent in operating an automobile, and fears about gasoline shortages have disappeared.

Other factors in the expected efficiency slowdown include the rising use of light trucks for passenger travel, a growing attraction for better performance—we estimate that increased power over the past seven years has cost the new car fleet at least one mile per gallon in efficiency—more and heavier luxury and safety equipment, and the potential for more stringent emission standards. Although such standards do not have to result in a significant fuel economy reduction, they might have this result without government intervention.

Figures 3 through 7 of my written testimony illustrate these points.

We believe that the fuel economy of the new car fleet is not likely to be much better than 30 miles per gallon by the year 1995 and 32 miles per gallon by 2000. Also, we expect that sales of light trucks will continue to pull down the overall efficiency average of the light duty fleet.

Although these fuel economy values, coupled with continued vehicle turnover, will allow the overall light duty fleet to continue to improve its efficiency for years to come, this level of improvement does not reflect the urgency of growing U.S. oil imports and new concerns over global warming.

Many in the Congress have urged that new higher fuel economy standards be imposed on the industry to force fuel economy improvements that the current market will not deliver.

I would like now to turn my attention to the prospects for such improvements and the means by which they may be achieved. First, I must state that there is no one optimal value of fleet fuel economy that we can all agree on. Depending on the level of our concerns with rising imports and global warming, on the technological risks we are willing to accept and impose on the auto industry, on our willingness to accept higher costs, on our willingness to force basic shifts in the makeup of our personal passenger fleet, and depending on the time frame we are concerned with, we could choose very different targets for future fleet fuel economy and different ways of reaching those targets. I cannot define for you a right target and a right strategy.

Second, I am willing to state a number, 33 miles per gallon by 1995, as a starting point in the complex process of choosing an appropriate fuel economy target for the U.S. fleet. 33 miles per gallon represents OTA's best estimate of the new automobile fleet fuel economy that can be attained by 1995 under the following conditions:

First, the necessary technologies are now in use in part of the fleet or on the very verge of introduction;

Second, the target can be achieved without forcing a basic change in the fleet, for example a shift to small cars;

Third, the cost of attaining the target in higher new car prices would be recaptured by lower fuel costs if performance and luxury do not change from today;

And fourth, the target could still be attained if performance and luxury continue to rise somewhat, but the costs would be higher.

Attaining a fleet fuel economy of 33 miles per gallon versus our projected 30 miles per gallon would be achieved primarily by deploying the necessary technologies—these are listed in table 4 in my written testimony—in a manner that maximizes their fuel economy benefits and, for some of the technologies, deploying them more quickly and in more models than may be the case without government pressure. The manner of deployment is likely to be the more important factor.

Also, it will become more difficult to reach the 33 miles per gallon target if certain technologies become much more widely used. We are particularly concerned about four wheel drive.

Higher fleet fuel economies than 33 miles per gallon can be achieved by 1995 by pushing harder on current technology, at higher cost, or by somehow shifting the makeup of the fleet toward smaller, more efficient vehicles. And in the longer run, many promising new technologies are being examined by various segments of the industry, and we believe that broad, aggressive development programs undertaken by the industry would stand a good chance of successfully moving some of these technologies into the fleet.

However, current market conditions do not encourage development of these technologies unless they have strong corollary benefits in addition to improved fuel economy, such as higher reliability, lower costs, or improved performance. Although some of the new technologies do promise additional benefits of this sort, there obviously is room for added incentives to bring new technology into the fleet at a faster pace.

Mr. Chairman, in your letter inviting OTA to testify at these hearings you asked for our views on current and future standards governing fleet fuel efficiency, and I would like to respond to this request. The domestic auto manufacturers have complained that the corporate average fuel economy standards favor those manufacturers that produce mainly small cars and discriminate against full line manufacturers. We agree.

Because small cars are more fuel efficient than large cars at the same technology level, the current uniform standards apply a more difficult and constraining technological challenge to makers of large cars. This is not an inherent characteristic of fuel economy standards. It is a result of the structure of the standards.

It can be remedied, if this is desired, by shifting to a standard that ties the level of the company's standard to some measure of the size of the vehicles it sells. To illustrate, I have constructed a hypothetical set of company by company standards, tied to the mix of vehicle sizes in each company's fleet.

These standards are designed to achieve a new car U.S. fleet average of 33 miles per gallon by 1995. I would be happy to explain this further in the question period.

Figure 10 in my written testimony illustrates the level of the individual company standards for nine of the major automakers. The standards range from 31.6 miles per gallon for one domestic manufacturer to 35.2 for a large Japanese manufacturer and 36 miles per gallon for another foreign manufacturer.

The advantage of standards such as this one is that they tend to equalize the technological challenge to each company. If the domestic manufacturers can maintain technical equality with their foreign competitors, standards such as this should not cause them to lose market share.

I conclude my testimony by noting that improving the fuel efficiency of the U.S. light duty fleet by more than a few miles per gallon involves bringing into play a number of different mechanisms, from accentuating the fuel efficiency potential of current technologies to accelerating the movement of new technologies from the laboratory into the fleet.

These mechanisms involve a wide range of technological risks and costs, and it is likely that an ideal conservation strategy will involve a number of coordinated measures, not just one standard.

It may be that a miles per gallon standard is the better measure to stimulate the near-term, low risk mechanisms, and that some other, more flexible measures may be better to stimulate the longer term, higher risk mechanisms.

Mr. Chairman, I urge you to explore a range of measures, including miles per gallon standards, economic incentives such as gasoline taxes and penalties and rebates for low and high efficiency vehicles, design competitions, joint industry-government research, and others.

That concludes my testimony. Thank you.

[The statement follows:]

INCREASING THE EFFICIENCY OF AUTOMOBILES AND LIGHT TRUCKS -- A COMPONENT OF A STRATEGY TO COMBAT GLOBAL WARMING AND GROWING U.S. OIL DEPENDENCE

Statement of

Steven E. Plotkin
Senior Associate
Office of Technology Assessment

Before the

Consumer Subcommittee
Committee on Commerce, Science, and Transportation
U.S. Senate

May 2, 1989

Mr. Chairman and members of the Subcommittee, thank you for this opportunity to discuss with you the results of our recent work on fuel consumption and energy efficiency of the U.S. fleet of light duty vehicles -- automobiles and light trucks (including vans). This work is part of our ongoing assessment of Technological Risks and Opportunities for U.S. Energy Supply and Demand, which OTA is conducting at the request of the Energy and Commerce Committee and its Subcommittee on Energy and Power.

I will discuss today our findings on the efficiency likely to be achieved by the light duty fleet if current government policies do not change, and the potential for additional increases in new vehicle energy efficiency that could be obtained by added incentives for fuel savings. I will also discuss briefly some of our work on possible alternatives to the current CAFE (Corporate Average Fuel Economy) standard, and share some of our thoughts on potential impacts of new regulations on the industry.

SUMMARY POINTS

- OTA agrees with the widely held view that, in the absence of radical changes in oil prices or in federal energy policy, U.S. oil imports will continue to grow during the next decade, surpassing 50 percent of total liquid fuels consumption by the early 1990s.

- The U.S. automobile fleet accounts for about 30 percent of all U.S. oil consumption; the total light duty fleet, which also includes vans and light trucks, accounts for 39 percent of oil consumption. These fleets represent the largest available targets for reducing U.S. petroleum use.

- Although the retirement of older, less efficient vehicles and the introduction of new, more efficient ones will continue to improve the average fuel efficiency of the light duty fleet over the next decade, the rate of improvement over the whole fleet will be slowed by a leveling off of further efficiency improvements in new vehicles. The fuel efficiency of the new car fleet essentially doubled between 1974 and today. In contrast, a combination of factors -- low fuel prices, increasing sales of luxury and performance features, continued demand for certain older car models, and so forth -- is expected to drastically slow the rate of future efficiency improvement, so that the year 2000 new car fleet efficiency may be only a few miles per gallon over today's 28 mpg. Also, if the popularity of light trucks as passenger vehicles continues, this will further decrease prospects for improving the efficiency of the light duty passenger fleet.

- During the remainder of the century, vehicle miles traveled (VMT) by automobiles will likely grow at between 2 and 3 percent per year, compared to the rate of 3 percent per year from 1970-1987. This growth will essentially cancel out the potential reduction in oil use from expected improvements in efficiency.

- Congress has been given strongly contradictory visions of the potential for improving new car fuel efficiency between now and the year 2000. Advocates for higher fuel economy argue that 45 mpg is a reasonable target for the new car fleet; the industry has argued that future improvements can come only slowly, and that efficiency values much above 30 mpg for the fleet will require technology that is not yet commercial.

- OTA concludes that the new car fleet could achieve 33 mpg by 1995 -- versus an expected level of about 30 mpg -- by intensifying the use of technologies that are already used in some car models. These technologies WILL be used more intensively in the future, but not to the extent that they could be, and not always in a form that maximizes their

efficiency potential. The attainment of this 33 mpg target would be cost-effective to consumers, but nevertheless consumers are unlikely to demand nor manufacturers to provide the necessary technological changes without additional incentives. An important caveat to the above conclusion: the achievable fuel efficiency level will be lower if trends towards higher power and towards certain efficiency-reducing options (such as four wheel drive) are not halted.

- **The potential for achieving significantly higher levels of fuel efficiency over the longer term appears promising because of the significant number of new technologies under investigation by different segments of the industry. However, the likelihood of successful commercialization, the eventual on-the-road performance achieved, and the costs of these technologies are all highly uncertain.**

- **The current structure of CAFE standards -- a uniform efficiency target that must be achieved by all manufacturers regardless of the mix of vehicles in their fleets -- places a more difficult technological burden on companies that sell a mix of vehicle sizes than on companies selling small vehicles only. If Congress wished to create a more level "playing field" -- in which the level of design and technology necessary to meet federal standards were approximately the same regardless of a manufacturer's vehicle mix -- it could turn to standards based on vehicle interior volume, EPA size class, or some other measure.**

- **One such standard, described in the text, would base a new standard on the actual size mix of vehicles sold by each manufacturer. If the mix of vehicles sold by each manufacturer in 1995 were the same as in 1988, an overall U.S. fleet fuel economy target of 33 mpg would require individual manufacturer targets ranging (for the 7 largest manufacturers) from 31.6 mpg (for a large domestic manufacturer) to 35.2 mpg (for a large Japanese manufacturer).[1]**

BACKGROUND

Trends in U.S. oil consumption, production, and imports have worsened over the past few years, adding to concerns about U.S. energy security, balance of trade, and environmental quality (see Figure 1). In 1985, the United States was enjoying substantial success in reining in oil

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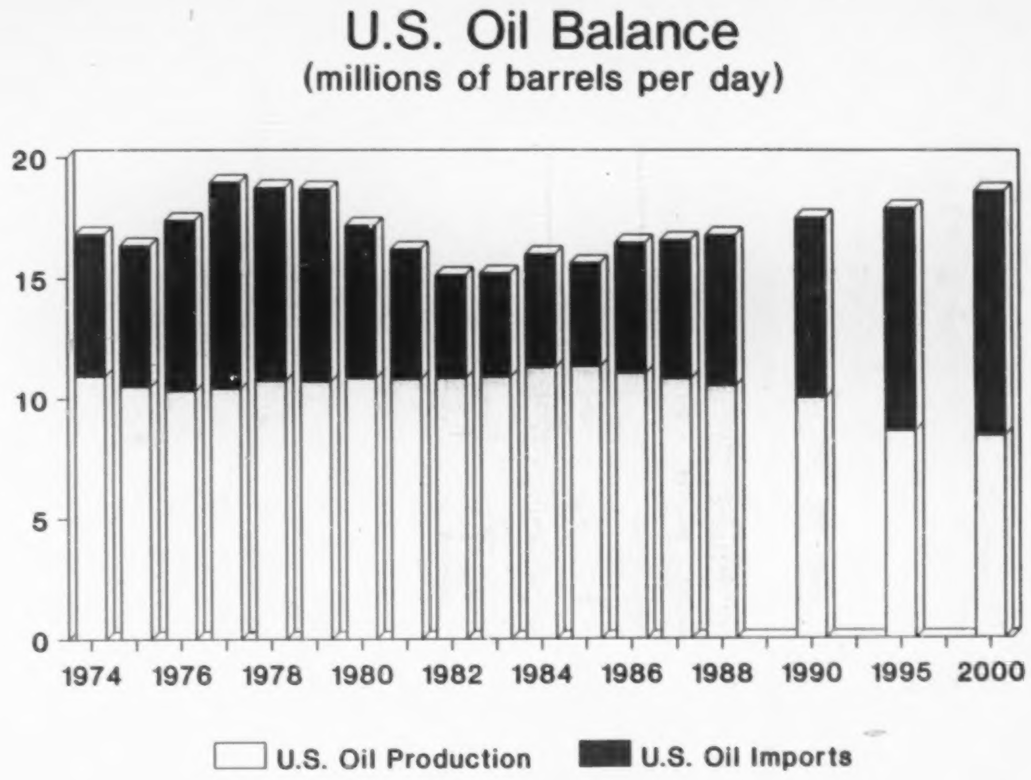
[1] Excluding vehicles sold but not produced by the manufacturer, e.g. "captive imports."

FIGURE 1.



SOURCE: ENERGY INFORMATION ADMINISTRATION, ANNUAL ENERGY OUTLOOK 1989 consumption, maintaining domestic production, and thus reducing imports. In that year, we produced nearly 9 million barrels per day (mmbd) of crude oil and 11.4 mmbd of total liquid fuels;[2] consumed 15.7 mmbd, down from 18.4 mmbd in 1977; and imported 4.3 mmbd, only 27 percent of total supply, down from a 1977 high of 8.6 mmbd or 46 percent. At the end of 1985, however, world crude oil prices plunged, drastically reducing the incentives for production investments and easing the economic restrictions on consumption. Since 1985, domestic oil production has fallen below 8 mmbd; consumption has risen back over 17 mmbd; and imports have grown to over 6 mmbd in 1988, or 37 percent of total consumption, and are still rising. In fact, most of the major forecasts of U.S. energy supply and demand project imports to exceed 50 percent of total oil[3] consumption by the early 1990s. ***OTA's previous review of domestic oil production prospects[4] and its preliminary review of oil demand generally confirm these projections.***

These trends have stimulated new interest in the many options available to decrease U.S. oil imports, including stimulation of domestic oil production, the use of alternative fuels, and increased energy efficiency. In addition, measures that increase U.S. energy security by means other than reducing imports -- such as adding to strategic oil reserves, better contingency planning, stimulating non-OPEC oil production, and so forth -- should also be a part of national energy planning.

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[2] that is, crude oil, lease condensate, natural gas plant liquids, processing gains, alcohols, and other liquids.

[3] That is, all liquid fuels, including crude oil, lease condensates, natural gas plant liquids, processing gain, alcohols, etc. Most statements of import dependence refer to imported crude oil and petroleum products as a fraction or percentage of total liquid fuels consumption.

[4] Office of Technology Assessment, U.S. Oil Production: The Effect of Low Oil Prices - Special Report, OTA-E-348, September 1987.

During the decade and a half since the first oil price shock, the major factor in reducing U.S. oil imports has been the marked reduction in the energy intensity of the U.S. economy, attributable at least in part to dramatic increases in the efficiency of energy use. "Success" in stimulating U.S. domestic production of oil has been measured largely as the ability to stabilize -- not increase -- total production. And while switching to alternative *non-liquid* fuels -- primarily to natural gas and, in the electric utility industry, to coal and nuclear energy as well -- has been successful, alternative *liquid* fuels have played virtually no role. In the future, increased efficiency still appears likely to be the key to any successful effort to reduce U.S. dependency on imported oil.

Increased efficiency also offers a clear way to combat trends to higher emissions of carbon dioxide, the primary greenhouse gas. Further, most energy efficiency measures have an overall environmental effect that is strongly positive.

Because of its importance to U.S. petroleum use and overall energy use, the transportation sector and, particularly, the fleet of light duty highway vehicles, is an important target for further efficiency efforts. In 1988, the transportation sector accounted for approximately 28 percent of the total energy consumed by the United States and 66 percent of all U.S.

petroleum consumption[5] (see Figure 2). Furthermore, a substantial portion of the remaining oil use involves the consumption of the byproducts of refinery production of transportation fuels,[6] so that the transportation sector's true energy impact is even larger.

The light duty highway fleet -- automobiles plus vans and light trucks used largely for passenger travel -- account for a very large portion of U.S. transportation energy use and overall oil use. In 1985, this fleet accounted for fully 39 percent of U.S. oil consumption and 16 percent of total energy consumption. The automobile fleet alone accounted for about 30 percent of U.S. oil consumption and nearly 13 percent of total energy consumption.[7] Consequently, these fleets represent the largest available targets for reducing U.S. petroleum use, and they have in fact become the focal points of recent efforts to involve the federal government more actively in energy efficiency efforts.

Proponents of government action to speed conservation efforts have argued that there is an inherent inconsistency in an Administration energy policy that simultaneously urges development of domestic oil resources in wilderness or fragile offshore areas (e.g., the Arctic National Wildlife Refuge, and offshore California) while initiating the rollback of the

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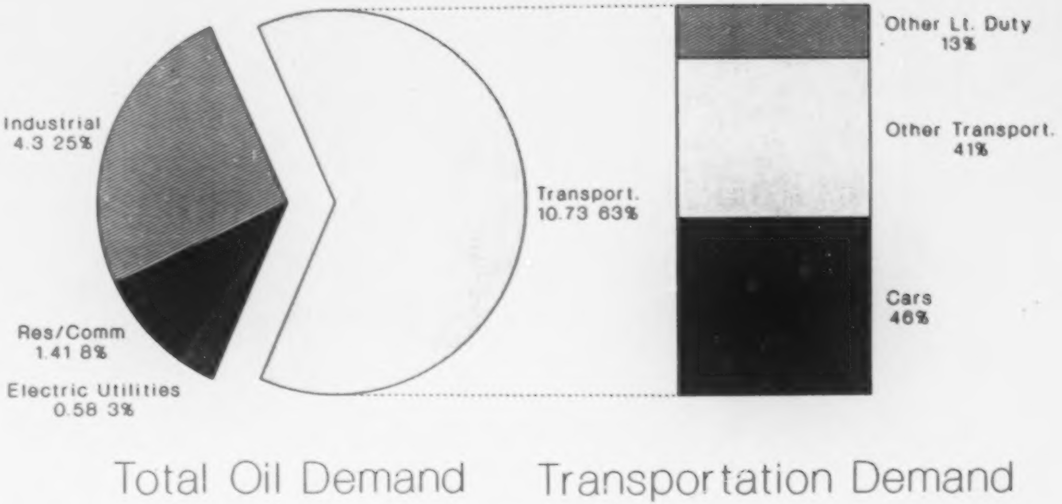
5. in British Thermal Units, or btu's. Because of the conventions of conversion to millions of barrels per day, measured in these units the percentage is 63 percent, as in the figure.
6. Data from Energy Information Administration, 1989 Annual Energy Outlook, DOE/EIA-0383(89), January 1989.
7. Data from Oak Ridge National Laboratory and Energy Information Administration.

FIGURE 2.

U.S. Oil Demand
(million barrels per day)



SOURCE: ENERGY INFORMATION ADMINISTRATION DATA

Corporate Average Fuel Economy (CAFE) standards from 27.5 to 26 mpg.[8] In addition, some energy efficiency analysts have argued that the passenger vehicle fleet could be made far more efficient than today's fleet -- with ultimately an average fuel efficiency of double or even triple current average efficiency -- with readily available technology and at a cost savings over the lifetime of the vehicles. Achievement of such efficiencies could save several million barrels per day in U.S. oil consumption.

In contrast, many industry analysts deny that the efficiency of the fleet can be improved this readily. They claim that, given the low price of gasoline, the industry has already introduced most of the available marketable efficiency measures into the fleet, and that further improvements will come slowly, at substantial cost, and with substantial uncertainty about performance and consumer acceptability.

Without question, considerable technical potential exists to increase the fuel efficiency of the U.S. light duty passenger vehicle

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8. These are "nominal" or laboratory fuel efficiency values as measured by the U.S. Environmental Protection Agency. The actual "in-use" efficiencies of new vehicles have tended to be consistently lower -- perhaps 15 percent lower -- than the official EPA mileage figures. The Gas Research Institute assumes that actual in-use mpg is 18.2 percent below the EPA values in their energy forecasts (P.D. Holtberg, et al, Baseline Projection Data Book; 1987 GRI Baseline Projection of U.S. Energy Supply and Demand to 2010, Gas Research Institute.); on the other hand, General Motors claims that the correct factor is less than 15 percent, and will become still lower with time. In any case, the result is that the actual in-use efficiency of today's new car fleet is substantially lower than the value, based on EPA tests, commonly cited. With incorporation of light trucks, the in-use efficiency of today's new passenger vehicle fleet probably is about 21 mpg.

fleet. However, there are strong forces -- economic, technical, and social -- that may counteract attempts to increase fleet fuel efficiency. The next few sections will discuss the efficiency and energy use likely to be realized by the fleet if driven only by market forces.

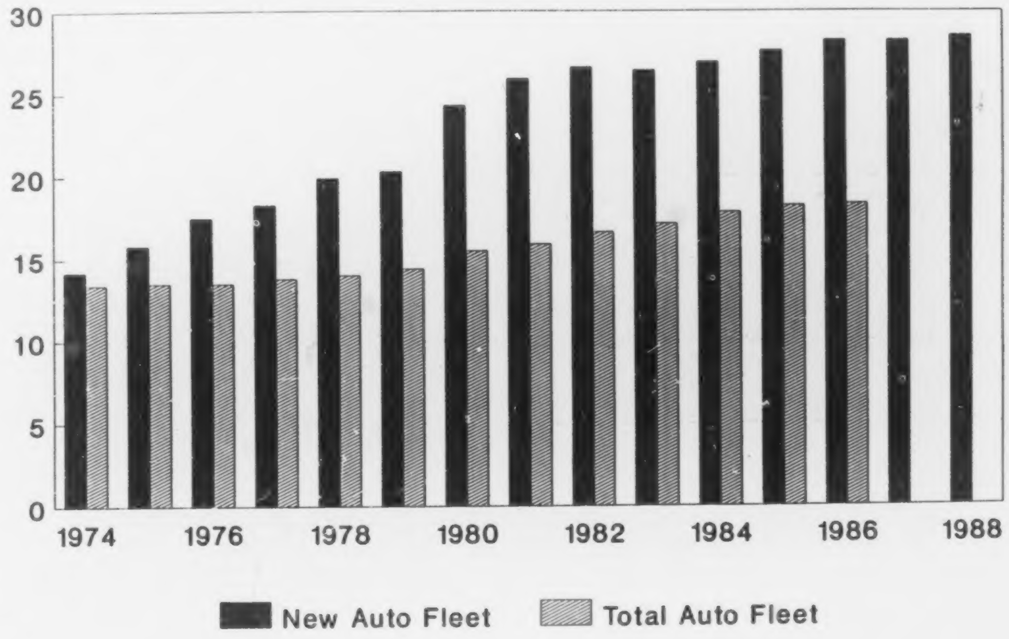
MARKET-DRIVEN FUEL EFFICIENCY

There is widespread agreement among energy analysts that, without significant changes in market conditions or government policy, improvements in the efficiency of the U.S. automobile fleet will slow from their pace of the past decade and a half, with most improvements during the next decade coming from diffusion into the fleet of technologies that are now already introduced into the new car fleet. In fact, as shown in Figure 3, the rapid improvements in new car fuel economy that began in the 1970s essentially ended in 1982 -- the slowdown has already begun.

The primary factor acting to reduce the potential for rapid increases in fleet fuel efficiency is the lack of strong market pressures for such increases. With lower prices for gasoline (and lower expectations for future price increases), relatively high *non-fuel* costs of operating a vehicle, and average fuel economy of most new vehicles already in the 20-35 mpg range, fuel costs have become a smaller part of total costs (Figure 4) and fuel efficiency has declined dramatically in importance as a factor in choosing a new vehicle. Presuming cost-effective efficiency improvements are available, the overall cost savings over vehicle lifetimes of any

FIGURE 3.

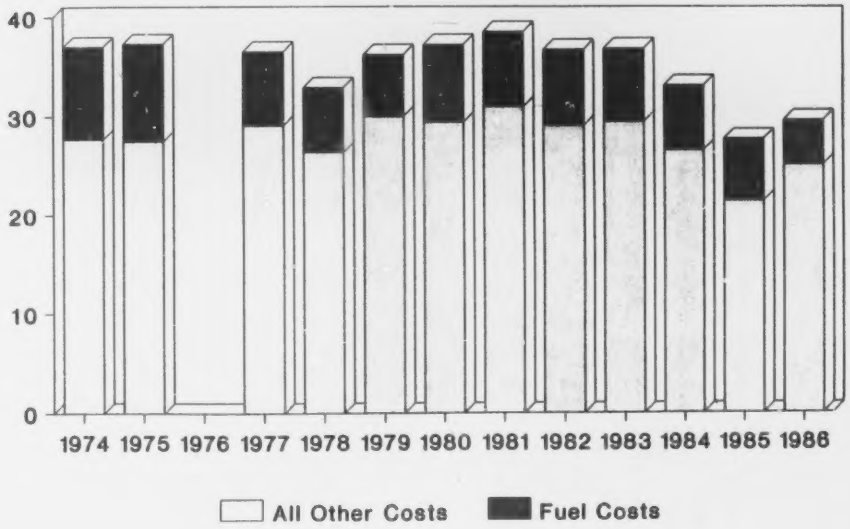
Trends in U.S. Auto Fuel Economy
(miles per gallon)



SOURCE: MOTOR VEHICLE MANUFACTURER'S ASSOCIATION,
OAK RIDGE NATIONAL LABORATORY

FIGURE 4.

Auto Fuel Costs vs. Total Costs
(cents per mile--1986 dollars)



SOURCE: OAK RIDGE NATIONAL LABORATORY

efficiency gain will tend to be a small portion of the total costs of ownership and operation.[9] Also, many technologies that will improve fuel economy while maintaining performance and other vehicle attributes will cost more than the technologies they replace and thus will likely raise the price of the vehicles. To the extent that automobile purchasers tend to focus on purchase price rather than on "life cycle" savings, high efficiency vehicles may be less marketable than less efficient but lower-priced vehicles.[10]

Available consumer surveys seem to confirm this expectation. The firm of J.D. Power and Associates conducts an annual survey that investigates the factors that consumers consider important in buying their next car. In 1980, when most analysts and consumers held expectations of rapidly escalating gasoline prices, about a third of the consumers surveyed listed fuel economy as the most important factor they would consider in selecting their next car.[11] By 1987, ***only 3 percent of consumers considered fuel economy as their primary selection factor.***

Other factors that may act to restrain increases in fleet fuel efficiency include:

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[9] See, for example, J. Goldemberg, T.B. Johansson, A.K.N. Reddy, and R.H.Williams, Energy for a Sustainable World, World Resources Institute, September 1987.

[10] Assuming that the vehicles are otherwise comparable, which they often are not. Note that in today's market, high efficiency vehicles often are "bottom-of-the-line" models that generally are less expensive than alternative models.

[11] J.D. Power and Associates, The Power Newsletter, Westlake, California, as reported in Patterson, P.D., Periodic Transportation Energy Report Number 4, September 8, 1988, and personal communication.

- **Growth in the use of light trucks for passenger travel.** Although light truck fuel efficiency has improved markedly since 1974, these vehicles remain substantially less fuel efficient than automobiles. Whereas the average 1987 nominal (that is, laboratory) fleet fuel economy for new automobiles was about 28 mpg, the fleet average for new light trucks was closer to 21 mpg[12]. This disparity in efficiency between autos and light trucks has a growing influence on the overall efficiency of the "light duty" fleet because sales of light trucks are rising relative to auto sales (Figure 5) and the passenger use of light trucks is growing far more rapidly than auto use. Light truck VMT grew at a rate that was over 5 times that for autos between 1970 and 1985; during this period, auto VMT grew 38 percent while light truck VMT tripled.[13] And according to 1985 Census data, light trucks are now being used more as passenger vehicles than as freight haulers, making them legitimately part of a light duty passenger fleet.

The difference between light truck and auto efficiency pulled the overall (nominal) new light duty fleet average down to about 25 mpg, and is likely to continue to hold down fleet averages in the future. The growing role of light trucks in passenger travel is a primary cause of the recent stagnation in the fleetwide average fuel economy of new light duty passenger vehicles, which has increased only 1.4 mpg since 1981;

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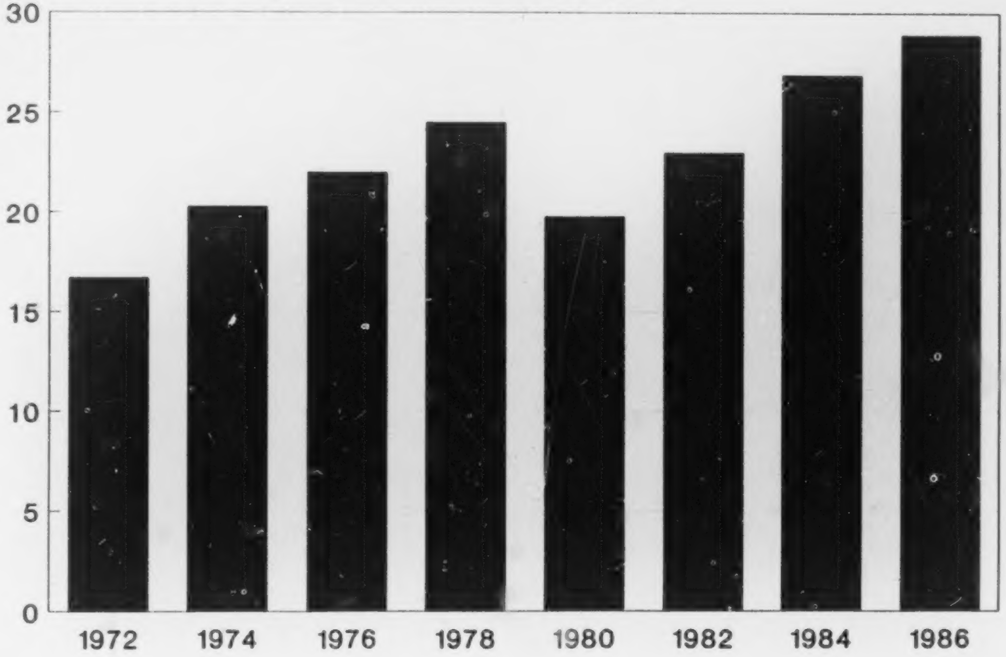
[12] Up from about 12 mpg in 1974.

[13] Patterson, P.D., "Analysis of Future Transportation Petroleum Demand and Efficiency Improvements," IEA Energy Demand Analysis Symposium, Paris, France, October 12-14, 1987.

FIGURE 5.

Sales of Light Trucks
Percent of Light Duty Sales



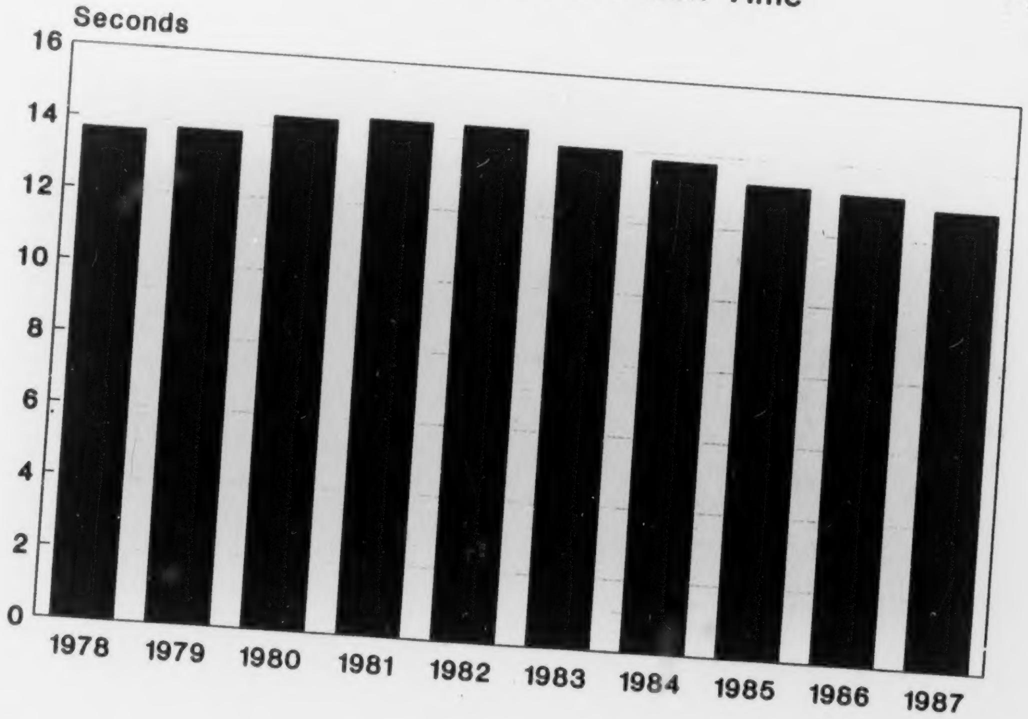
SOURCE: OAK RIDGE NATIONAL LABORATORY

the larger numbers of light trucks in the fleet provided a counter to efficiency gains within each portion of the fleet.

- A growing attraction among purchasers of new automobiles to more powerful (and thus less fuel efficient) automobiles. For example, as shown in Figure 6, the average 0-60 mph acceleration time for new vehicles has decreased in every year since 1982. Part of this trend is simply a recapture of performance levels lost earlier to emission control and satisfaction of CAFE standards; strong consumer objections to reduced power levels were raised by consumers in the early 1980s. Although the preference for increased performance may well disappear in the future, it is worrisome to those concerned with fuel conservation. An important consequence of this consumer preference is that drive-train improvements (such as engines with four valves per cylinder and turbochargers) with the potential to either increase fuel efficiency or boost horsepower from previous levels have been introduced in configurations that emphasize power increases rather than fuel savings.

There is not a precise formula to define the relationship between power and fuel economy. One examination of performance data for different models of the same car, with different performance, found that fuel economy is roughly proportional to the square-root of acceleration time. This relationship implies that the reduction in average acceleration time from 14.4 seconds in 1982 to 12.9 seconds in 1987 caused a decline in the fuel economy of new 1987 cars from a hypothetical 29.6 mpg (had performance remained the same) to the actual

FIGURE 6.



New Car Performance
0-60 MPH Acceleration Time

SOURCE: ENVIRONMENTAL PROTECTION AGENCY

28.0 mpg.[14] Another analysis found that the effect of the 1982-1987 performance gain was a 3-4 percent decline in fuel economy -- about 1 mpg, or from about 29 mpg to the actual 28.0 mpg.[15]

- Additional luxury and safety equipment on new cars. Although air conditioning and power steering have penetrated over 80 percent of the fleet, and further increases will be small, other equipment such as power seats, sunroofs, and power locks and windows may gain additional market share and can add significant weight to the vehicle. In addition, four-wheel drive, which may add 150-200 pounds to a vehicle and cut its fuel economy by 12-15 percent, is gaining in popularity. And safety equipment such as air bags (30-45 lbs.) and anti-skid brakes (30-45 lbs) will add further weight. The net effect of greater penetration of these technologies could be as large as a 3-5 percent decrease in fuel economy.[16]

- More stringent emission standards, especially for nitrogen oxides. If proposed new federal standards on exhaust and evaporative hydrocarbons and nitrogen oxides are enacted, manufacturers will choose from alternative strategies that will trade off cost, fuel efficiency, and emissions. There are approaches available to the the manufacturers -- for example, increasing the rhodium content of vehicle catalyst systems -- that would allow a more stringent nitrogen oxide standard to be met with no or minor fuel economy penalty, but at an added cost.[17] On the other hand, if the manufacturers perceive that consumers do not value fuel economy highly, they may choose control strategies that add little or no cost but sacrifice more fuel economy. In addition, the manufacturers could choose to add technologies that have potential for both efficiency improvement and emission control -- such as multipoint fuel injection -- in ways that maximize the emission reduction effects but sacrifice some of the efficiency potential. In these cases, the emission standards would have caused some potential improvement in fuel economy to be foregone. Historically, manufacturers have pursued a variety of strategies to achieve previous standards: to meet the 1981 emission standards, many Japanese manufacturers chose to use oxidation catalyst technology and accepted an efficiency loss of 6 to 8 percent; General Motors met the same standard with "closed loop" electronic fuel control systems with three-way catalysts that incurred no efficency loss.[18] EEA has estimated the potential fuel economy penalty (or gain foregone) of the proposed .4 grams/mile standard for nitrogen oxides to be 2-4 percent *if the manufacturers choose to sacrifice efficiency in*

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[14] Ross, M., draft contractor report to OTA, 1988.
[15] Energy and Environmental Analysis, op cit.
[16] Energy and Environmental Analysis, op.cit.

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17. Sierra Research, Inc., The Feasibity and Costs of More Stringent Mobile Source Emission Controls, prepared for the Office of Technology Assessment, January 20, 1988. The report estimates a cost per vehicle of $139 to achieve an 0.25 grams/mile standard for non-methane hydrocarbons and an 0.4 g/mi standard for NOx with no fuel economy penalty, and no foregone fuel economy improvements. The technology involved is an increase in rhodium loadings by 0.5 grams/vehicle in the exhaust catalyst and the addition of a bypassable start catalyst. Another OTA contractor -- Energy and Environmental Analysis, Inc. -- believes that satisfaction of the above standards would at least cause some future fuel economy improvement to be foregone (K.G. Duleep, Energy and Environmental Analysis, Inc., personal communication).
18. Energy and Environmental Analysis, Inc., op.cit.

order to minimize costs.[19]

- **Slower replacement of the automobile fleet, so that technological improvements introduced into the new car fleet will take longer to diffuse into the total fleet.** Whereas in 1969 cars more than 10 years old accounted for only about 7 percent of vehicle miles traveled (VMT) and fuel consumed, by 1977 these older vehicles accounted for about 13 percent of VMT and fuel, and by 1983 they accounted for almost 20 percent of VMT and 23 percent of fuel.[20]

- **No signs that U.S. drivers will shift to smaller cars.** Although average *exterior* size and vehicle weight have been reduced substantially -- with great positive effect on fuel efficiency -- the average interior volume of new automobiles in the U.S. fleet has remained virtually constant for 10 years: it was 109 cubic feet in 1978, and 108 in 1987 (Figure 7). On the other hand, the vehicles often cited as demonstrating the potential for major fleet efficiency improvements -- the very high efficiency vehicles in the current fleet and most of the ultra high efficiency prototypes -- are smaller. Although substantial efficiency gains can be made without a shift to smaller cars -- only about one tenth of 1978-1984 progress in new car efficiency was due to shifts to smaller cars[21] -- the apparent inability to effect such a shift remains costly to prospects for future gains.

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[19] Ibid.

[20] U.S. Department of Energy, Assessment of Costs and Benefits of Flexible and Alternative Fuel Use in the U.S. Transportation Sector. Progress Report One: Context and Analytical Framework, DOE/PE-0080, January 1988.

- Continued consumer demand for "old-fashioned" car models. U.S. manufacturers have found that a portion of new car purchasers prefer large, heavy, rear-wheel drive models even though newer, more fuel-efficient designs appear to be functionally superior. Because the manufacturers can obtain high profit margins on these models, they have kept them in the fleet despite prior plans to phase them out.

If current low oil prices persist, the relatively modest benefits to the individual automobile owner of improving fuel efficiency beyond about 30 mpg are unlikely to provide much incentive to manufacturers who must factor in both market risk and the risk of reliability problems into their design and marketing decisions. Manufacturers are likely to be reluctant to introduce a major new fuel-efficient technology unless it offers other important benefits as well, and they are likely to forego some of the potential efficiency benefits to maximize other benefits. Some possible side benefits include better emission control characteristics (e.g., from better combustion controls, or merely from the smaller mass of fuel burned per mile) and improved performance (e.g., from introducing continuously variable transmissions). And despite the existence of some side benefits, improvement in new car fuel economy is expected to be incremental in nature and quite slow as long as the current market environment persists.

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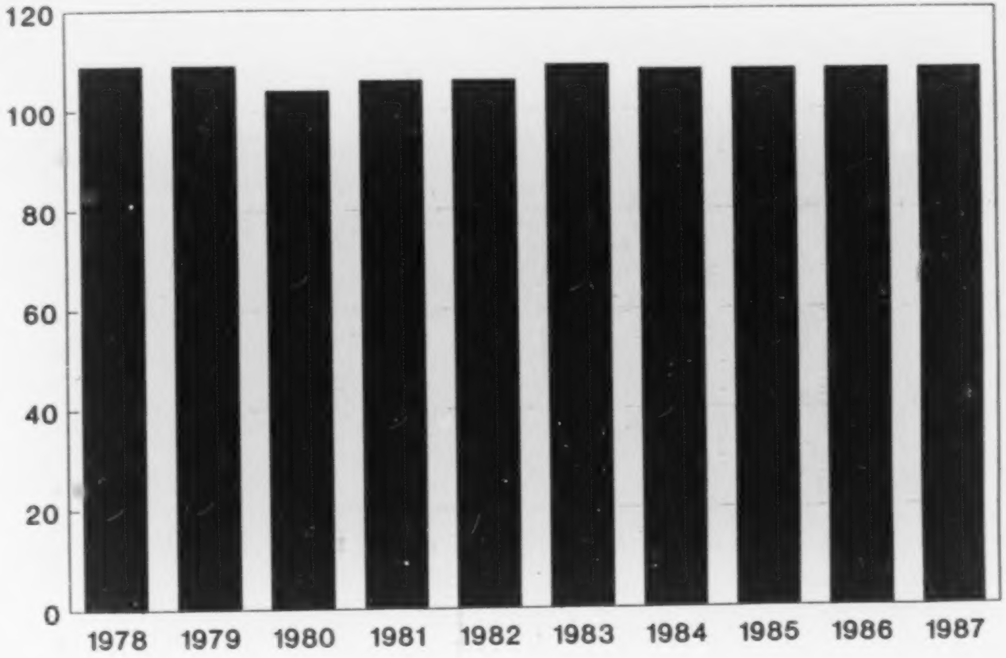
[21] Patterson, P.D., "Trends in Automobile Fuel Economy and Energy Use," ORSA-TIMS Conference, Boston, MA, April 30, 1985.

FIGURE 7.

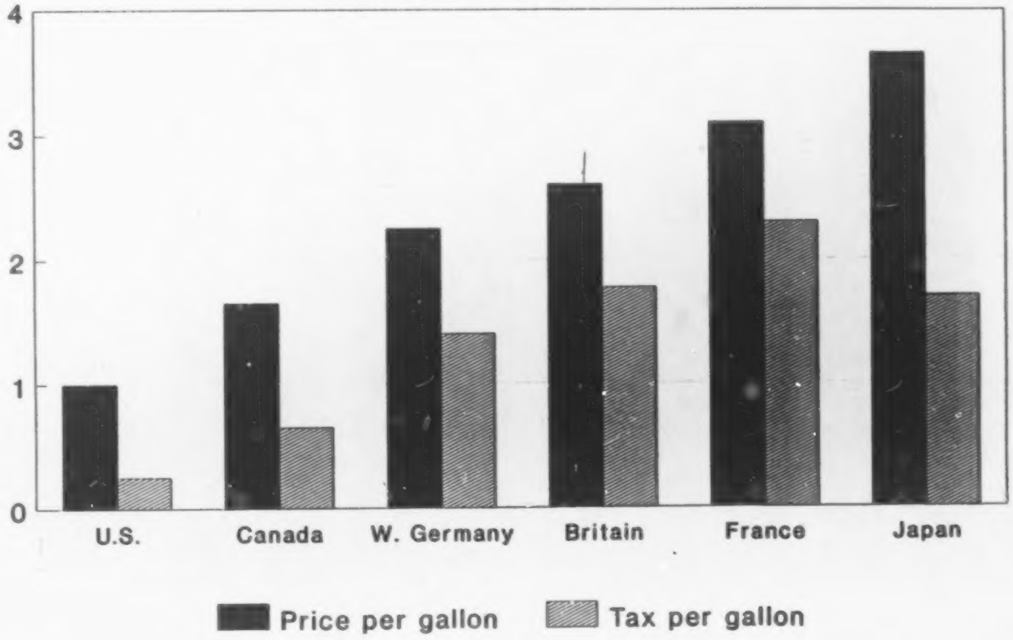


Interior Volume of New Cars
(cubic feet)

SOURCE: OAK RIDGE NATIONAL LABORATORY

FIGURE 8.

Gasoline Price with Tax
(dollars per gallon)



SOURCE: BUSINESS WEEK

Thus, the future course for the U.S. new vehicle fleet -- absent sharp increases in world oil prices or policy intervention such as gasoline excise taxes (which amount to over $2/gallon in many other industrial countries; see Figure 8) or tightening of CAFE standards -- appears to be only modest additional increases in fuel efficiency as engineering improvements that are well along in development gradually are introduced. With such technological and design improvements, and, above all, with the gradual retirement of older, less efficient vehicles, the fuel economy of the entire passenger vehicle fleet will continue to rise during the remainder of this century.

Projections of both new car and light duty fleet fuel economy beyond a few years from today are at best educated guesses, and should be treated as such. Some recent projections include:

- The Energy Information Administration's projection for year 2000 new automobiles is 34 mpg (EPA), for new light trucks, 25.3 mpg, and for the entire light duty fleet, 24 mpg (in-use).[22]

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[22] Energy Information Administration, 1989 Annual Energy Outlook

- Energy and Environmental Analysis's projection for year 2000 new automobiles is 31.3 mpg (EPA), for new light trucks, 23 mpg, and for the entire light duty fleet, 22.2 mpg (in-use).[23]

- Data Resources, Inc.'s projection for the year 2000 *domestically produced* new automobiles is 30.1 mpg (EPA).[24] This average would be expected to be slightly less than the average for the entire fleet.

Vehicle fuel efficiency could, of course, easily be somewhat higher or lower than these projections. For example, a combination of factors -- additional safety equipment added, continued increases in vehicle performance, more stringent emission standards that are met by least-first-cost (but fuel inefficient) measures, continuation of trends in imports towards larger and more luxurious (and powerful) vehicles, and growing market share for vans and light trucks -- could make it difficult for the new vehicle fleet to improve significantly beyond today's level. Yet a renewal in consumer and public policy interest in fuel economy could cause fleet efficiency to rise above the projected levels by a combination of shifts in market shares of alternative models, more rapid diffusion of existing technology into the fleet, and an acceleration of the introduction of new technologies.

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23. Energy and Environmental Analysis, Inc., The Motor Fuel Consumption Model, Fourteenth Periodical Report, Draft, for Martin Marietta Energy Systems, Inc., December 6, 1988.
24. Data Resources, Inc., Energy Review, Winter 1988-89.

OTA believes that a likely fuel economy value for the components of the new vehicle fleet in the year 2000, given current trends and no radical changes in either government policy or fuel prices, would lie in the same range as these projections, although we feel that the EIA value is somewhat optimistic. A reasonable mid-range value is about 32 mpg (EPA) for automobiles and 24 mpg for light trucks, yielding an overall light duty new vehicle fleet average of about 29 mpg.[25] The corresponding *in-use* average of the entire light duty fleet would be about 22-23 mpg.

TRAVEL DEMAND

The likelihood that the market will act to slow down improvements in fleet efficiency is particularly worrisome to energy policy analysts because the complementary component of oil use -- the vehicle miles traveled (VMT) -- is expected to continue to rise. The rate of increase in light duty passenger vehicle miles traveled between 1970 and 1987 was very large -- about 3 percent per year. For the remainder of the century, the rate of increase is likely to be smaller for demographic reasons, but there is considerable uncertainty, and quite conceivably the rate of increase could remain high.

As shown in Figure 9, the rise in VMT over the past several decades has been almost constant, as expected "saturation points" in auto ownership and travel demand did not occur. Initial assumptions that vehicle

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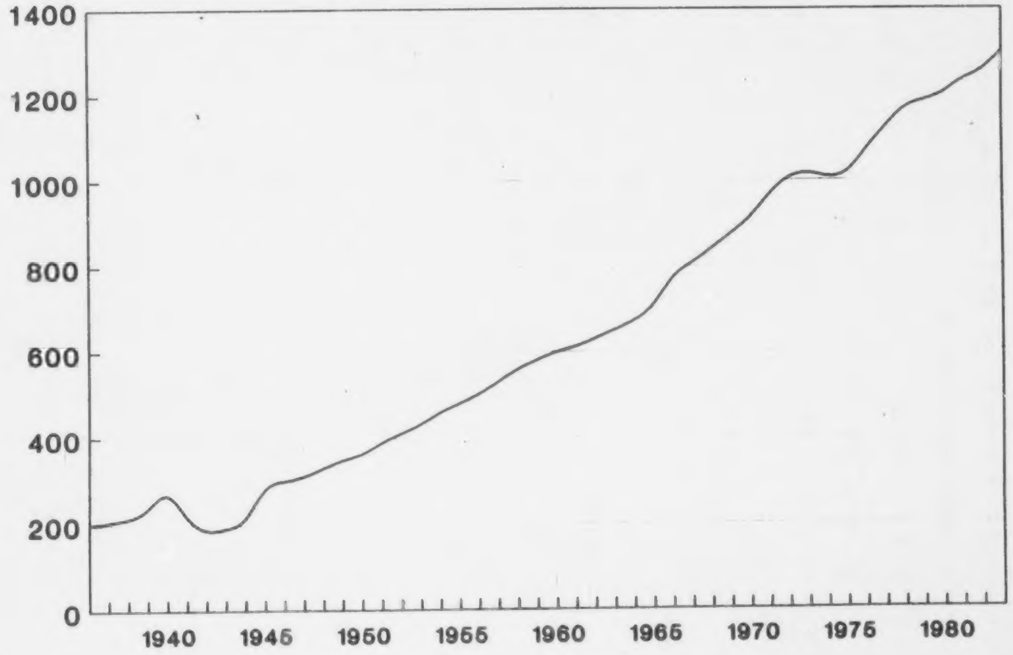
[25] Assuming that light trucks account for about one third of the new light duty fleet.

FIGURE 9.

U.S. Auto Fleet Travel
(vehicle miles travelled, VMT)



SOURCE: FEDERAL HIGHWAY ADMINISTRATION

saturation would occur at 1 vehicle per household were surpassed in the United States in the 1930s. Then, a proposed saturation point of 1 vehicle per worker was surpassed in the mid-1960s. Expected saturation of 1 vehicle for each licensed driver was surpassed in 1983.[26] And for the past 30 years, VMT per vehicle has remained at about 10,000/year, driving total U.S. VMT upwards at the rate of expansion of the fleet.[27] The year-by-year rise in travel faltered only twice, and then only for very brief periods when gasoline supply problems were coupled with very sharp price increases.

More than half of the increase in VMT over the past 15 years can be attributed to the increase in the number of adults of driving age; the remainder was due to the growth in driving per licensed driver and the higher proportion of licensed drivers in the population -- the latter due largely to the growth of women in the workforce.

The Energy Information Administration's recent 1989 Annual Energy Outlook[28] projects personal travel by autos and light trucks to grow at 2.1 percent/year for the 1988-2000 period, reflecting their judgment that the market for such travel will slow somewhat from its steady rate of the past few decades. Other recent forecasts by Argonne National Laboratory, Energy and Environmental Analysis, Inc., and the Federal Highway Administration[29] show 1985-2000 growth rates for the light duty fleet of 2.27 percent, 2.75 percent, and 2.13-3.14 percent, respectively -- higher than EIA's rate but also generally below the recent trend.

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[26] Patterson, P.D., "Analysis of Future Transportation Petroleum Demand and Efficiency Improvements," IEA Energy Demand Analysis Symposium, Paris, France, Oct 12-14, 1987.

[27] Ibid.

[28] Energy Information Administration, 1989 Annual Energy Outlook, DOE/EIA-0383(89), January, 1989.

OTA agrees that a decreased growth rate for travel is likely. However, there is considerable room for argument about the likelihood of a decrease, especially because of the stability of vehicle mileage trends in the past. Factors that will affect future VMT include:

women in the workforce. During the past few decades, the growing share of women working, and therefore needing to commute, has contributed significantly to rising levels of light duty vehicle travel. Between 1969 and 1983, the percentage of adult women in the workforce rose from 39 percent to 50 percent, and of those working, the percentage with drivers licenses rose from 74 percent to 91 percent. Further increases in the share of women working will continue to affect the demand for transportation services during the next few decades, but *probably* at a slower rate because the current percentage of working women is now high. However, women, working or not, still do not drive nearly as much as men; this leaves open the possibility that future shifts in lifestyles among women could drive VMT at a higher rate than predicted.

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[29] The first two forecasts are described in Patterson, P.D., "Analysis of Future...," op.cit. The growth rates were calculated from data obtained from the author. The last forecast is from Federal Highway Administration, The Future National Highway Program, 1991 and Beyond. Working Paper No. 2, Trends and Forecasts of Highway Passenger Travel, October 1987. For this last forecast, the cited growth rates are actually for 1983-2005.

number of adults. The rate of growth of adults of driving age will slow as the baby boom passes. After 2000, however, the rate of increase will depend on future birth rates, which are uncertain.

possible saturation among high mileage drivers. Employed men between 25 and 54 years of age drive more than any other large group -- about 18,000 miles per year. This represents an average of 1.5 hours per day spent driving. Although "common sense" about saturation of driving has been wrong before, it is at least possible that this group may be nearing saturation.

changing economic structure. The growth in part time work and the shift in the economy towards more services may lead to increased driving, by bringing more individuals into the workplace and by increasing delivery requirements. The potential for delivering certain types of services, especially information, electronically may eventually substitute for some transportation, but thus far such trends have not been observed.

traffic congestion. The increasing congestion of metropolitan areas will alter travel patterns. Congestion will decrease the fuel efficiency of those trips that are made; discourage other trips (or shift them to public transportation, or to the electronic media where possible); encourage some people to work closer to home or move closer to work; and encourage businesses to move to the less congested fringes, increasing travel requirements. The net effect on fuel demand is unpredictable.

In OTA's view, the most predictable aspects of the above factors are the lower number of persons reaching driving age and the likely slowdown of the effects of women entering the workforce, both acting to slow the growth in VMT. Nevertheless, the uncertainty associated with the various factors affecting travel demand probably allows a range of feasible growth rates of 2-3 percent *without* considering the potential for future price shocks. An unexpected large increase in gasoline costs, or supply problems, could cause the growth in personal travel demand to fall below these levels, or even to go negative.

LIGHT DUTY FUEL USE

The effect of a combination of moderate improvements in vehicle efficiencies and a steady but slightly slower increase in miles driven -- which OTA considers the most probable future for personal highway travel during the next decade -- will be that, absent policy changes, the fuel consumption of the passenger vehicle fleet is likely to change little between now and 2000; the expected efficiency improvements will approximately offset the expected increase in miles driven.

To be more precise, the fuel efficiency and vehicle miles traveled projections of the Energy Information Administration and Energy and

Environmental Analysis, Inc., cited above, imply that year 2000 fuel use by autos and light trucks combined will be, respectively, 2.6 or 2.2 percent higher than today's. This is a very small change for an 11 year period.

A projection of stagnant automotive fuel consumption is quite in line with the experience of the past decade and a half. Between 1973 and 1987, the in-use fuel economy of the U.S. automobile fleet improved from about 13.3 mpg to 18.2 mpg; light truck fuel economy improved sharply, as well. In 1987, this improvement amounted to a savings of about 1.8 mmbd over what oil consumption *would have been* had 1987 driving levels been accomplished with 1973 fleet efficiency[30] (at about $1.00/gallon, this equates to an annual savings to U.S. drivers of close to $30 billion per year); because mileage driven increased substantially during this period, the actual petroleum consumption of the fleet changed little, rising from 5.41 mmbd in 1973 to 5.70 mmbd in 1987.

Of course, alternative projections differ somewhat about this. For example, a recent Chevron forecast (World Energy Outlook, October 1987) projects a decrease in gasoline usage of 0.3 percent per year to the year 2000, whereas Conoco (Energy Outlook Through 2000, September 1987) projects a 0.5 percent per year *increase* in gasoline demand through 2000.

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[30] Depending on assumptions, the magnitude of the savings can be somewhat different. For example, a recent World Resources Institute report (J. Goldemberg, et al, Energy for a Sustainable World, September 1987) calculates the savings for 1975-1985 -- a shorter time period -- to be 2.4 mmbd. Although the difference is substantial, the point remains the same.

THE POTENTIAL FOR STIMULATING HIGHER LEVELS OF FUEL EFFICIENCY

Despite the forces exerting upward pressure on gasoline consumption, there clearly are a variety of technological and design changes that could substantially raise the fuel economy of the passenger vehicle fleet, and some of these will be cost effective even at current low gasoline prices. The disappointing *market* prospects for future improvements in passenger vehicle fuel efficency, discussed above, imply that there may be considerable technological "headroom" -- and potential for shifts in the mix of vehicles purchased -- that can be captured with non-market solutions (regulation) or additional market incentives. In other words, additional fuel savings can be achieved with fuel taxes, fuel economy standards, or other policy mechanisms encouraging increased efficiency, although there is substantial controversy about the likely magnitude and timing of fuel savings, the costs, and the effects on the industry.

Arguments of the Energy Conservation Community

Analysts from the energy conservation community can marshall a variety of arguments to support the proposition that the efficiency of the U.S. light duty new car fleet can be greatly increased over the next 20 years.[31] First, because market pressures have held down gains in fleet efficiency during the 1980s, they argue that government action to change market pressures could reverse this trend. In particular, lower gasoline prices reversed previous trends towards smaller cars and dropped the market shares of fuel efficiency leaders such as the Rabbit diesel. Presumably, government actions to raise gasoline prices, raise the purchase price of fuel-inefficient vehicles, and possibly lower the purchase price of fuel efficient vehicles could substantially increase fleet efficiency even without the introduction of new technologies, by encouraging purchasers to buy cars in lower size classes and/or the more fuel efficient models in each size class, and encourage manufacturers to use available fuel efficiency technologies more widely in their fleets. In the longer run, these actions would encourage manufacturers to develop new technologies and consumers to purchase them.

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[31] See F. Von Hippel and B. Levi, "Automobile Fuel Efficiency: the Opportunity and the Weakness of Existing Market Mechanisms," Resources and Conservation, pp. 103-124, 1983, and Bleviss, D.L., The New Oil Crisis and Fuel Economy Technologies: Preparing the Light Transportation Industry for the 1990s, Quorum Books, 1988.

Second, the conservation community claims that a variety of fuel efficiency technologies exist today, in fully commercialized form, that are not as widely disseminated through the fleet as they could be. Table 1 lists a number of technologies whose introduction or wider use offer a potential to improve fleet fuel efficiency.

Third, several car manufacturers have produced vehicle prototypes that are reported to achieve very high fuel efficiency (see Table 2). The conservation analysts contend that the existence of these prototypes provides concrete evidence of the high long-term potential for improving fleet efficiency.

Finally, a variety of new technologies at various stages of development have been identified that appear to show promise of achieving

Table 1. Reported Efficiency Improvements for Developed or Near-Term Technology

Technology	Percentage Improvement Over 1987 Base[1]	
	EEA[2]	Industry[3]
Engine Improvements[4]		
4 valve per cylinder	10.0/5.0.	4-5 or less
Overhead camshaft	6.0	low
Roller cam followers	1.5	0.5-4.0
Low friction rings/pistons	1.5	
Throttle body fuel injection	3.0	0-3
Multipoint fuel injection	7.0	4
Intake valve control	4.0	1-2
Four speed automatic transmission	7.5	5-6
Electronic transmission control	1.5	low
Aerodynamics, $C_D = 0.34$	3.4	3
Tire improvements	0.5	
Lubricants (5W-30)	0.5	
High efficiency accessories	1.0	

Notes: 1. Values may not be additive.

2. Energy and Environmental Analysis, Inc., Developments in the Fuel Economy of Light-Duty Highway Vehicles, contract report to OTA, August, 1988, with minor revisions.

3. Based on comments received in review of the EEA draft report and at an OTA workshop on automotive fuel economy, September 14, 1988.

4. Because newly designed engines all have multiple improvements, the efficiency improvements represented by individual design changes are not easily separable.

Table 2. High Efficiency Automobile Prototypes

Prototype	Fuel	Fuel Economy (miles per gallon)	Passenger Capacity (persons)
VW Auto 2000	diesel	66	4-5
Volvo LCP 2000	multifuel	69	2-4
Renault EVE+	diesel	70	4-5
Toyota Ltwght Compact	diesel	98	4-5

Notes: fuel economies converted to equivalent EPA test values, using conversion factors recommended by the International Energy Agency. Details, and further descriptions of the vehicles are in the source document. Vehicles do not necessarily meet all U.S. emissions or safety requirements.

Source: Table 10. Fuel Economy for Passenger Automobiles, in J. Goldemberg, et al, Energy for a Sustainable World, World Resources Institute, September 1987.

large efficiency gains. For example, new designs of a two-stroke engine for automobile applications have been said to be capable of achieving fuel economy gains of 20 percent or more over conventional four-stroke engines with concurrent reductions in manufacturing costs.[32] Other engine designs said to hold considerable promise include direct-injection diesels and adabiatic diesels. Table 3 lists some of the potential efficiency technologies. Advocates of higher fuel economy standards and other efficiency-oriented policy actions believe that such measures will speed up development and introduction of these new technologies.

Analysts associated with the American Council for an Energy Efficient Economy have recently proposed a year 2000 efficiency goal for new vehicles of 45 mpg (EPA) for autos and 35 mpg for light trucks[33]. Achieving these goals would raise average in-use fleet mileage to about 27 mpg by 2000, up from a projected level of about 22 mpg. If total annual mileage traveled were 2.21 trillion miles, this efficiency improvement (27 vs. 22 mpg) would save about 1.2 mmbd of oil or, at $1.00/gallon, over $20 billion per year by 2000, and more in future years as the technology diffused into the fleet. The energy conservation community argues that

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[32] "Detroit Gets Serious About Two-Stroke Engines," Business Week, July 18, 1988. Also, see Plohberger, D., Mikulic, L.A., and Landfahrer, K., "Development of a Fuel Injected Two-Stroke Gasoline Engine," SAE Technical Paper Series #880170, 1988.

[33] Chandler, W.U., Geller, H.S., and M.R. Ledbetter, Energy Efficiency: A New Agenda, American Council for an Energy Efficient Economy, Washington, D.C., July 1988. The authors suggest several policies to complement and help achieve this goal, including gasoline taxes, new "gas-guzzler" taxes, and a "gas-sipper" rebate program. They also suggest that efficiency standards be carefully structured to avoid past problems of unfairness, for example, by basing them on vehicle interior volume.

Table 3. Future Technologies for Improving Light Duty Vehicle Efficiency

Variable-Geometry Turbochargers. Increases effectiveness of turbocharging at low loads, allows engine downsizing.

Improved electronic controls. Adjustment of engine operating parameters (e.g., ignition timing) based on direct measurement of cylinder pressure and other operating conditions.

Condenser engine cooling. Allows fast warm-up, reduced coolant yields reduced weight.

Advanced lubricants (solid and gaseous).

Oxygen enrichment of air intake. Using membrane technology to enrich oxygen content of intake air, effect similar to but more effective than turbocharging.

Adiabatic diesel. Low heat rejection engine achieved by heavy use of ceramics. Couples removal of cooling requirement and capture of exhaust energy through turbocharging or supercharging.

Continuously variable transmissions. Allows engine to be kept at optimum operating speed throughout the driving cycle. Currently available for small engines only.

Advanced materials. Obtaining substantial weight reduction through use of improved plastics and further use of high strength steels, aluminum, magnesium, ceramics.

Advanced tires. Reductions in rolling resistance through improvements in design and/or use of advanced materials, e.g. liquid-injection-molded polyurethane.

Engine stop-start and energy storage. Engine shut-down during idle and braking, coupled with flywheel storage to power accessories and aid restart.

Source: Bleviss, D.L., The New Oil Crisis and Fuel Economy Technologies, Quorum Books, 1988.

these goals are both technically achievable and cost-effective even at today's gasoline prices, based on available vehicle prototypes and cost and performance analyses for a variety of individual technologies.

Industry Arguments

Industry analysts argue strongly against claims that the new car fleet fuel efficiency can readily be increased this much. For example, they argue that the performance of the technological improvements added to the fleet during the past decade, while impressive, still fell short of projected levels. They reject many of the efficiency improvement projections for fuel efficiency technologies claimed in the energy conservation literature, noting that the process of moving from the laboratory and test track to the fleet involves numerous engineering compromises to allow reliable and efficient manufacture and practical servicing of the technology. They also argue that many of the projections of high fuel efficiencies associated with the use of multiple technologies involve substantial "double-counting." They stress the difference between "technical availability" and "marketability," noting that many available technologies -- such as diesel engines -- have proved effective at increasing fuel efficiency but have been soundly rejected in the marketplace because of their failure to match other market requirements. Further, they argue that the many confident predictions of imminent introduction of new technologies fail to consider the difficult remaining technical problems that may slow or even prevent these technologies from being introduced (for example, they are concerned that two stroke engines will have difficulty in meeting emission standards for nitrogen oxides).

And they are skeptical of the importance of high mileage prototypes in predicting market potential, arguing that these vehicles are designed solely to achieve high efficiency and could not realistically compete in the marketplace. Finally, they claim that a number of government regulations, in particular those on emissions and vehicle safety, as well as current marketplace interest in greater power and more luxury equipment, will act counter to attempts to improve fuel efficiency. Thus, at least part of any efficiency improvements added to the fleet will act to nullify the effects of these factors rather than actually raising fleet efficiency from present levels. The industry claims that their experience in the 1980s with efficiency improvements implies that it is *not* feasible to attain the efficiency goals advocated by the conservation community.

Industry analysts and others have also warned that a strong government push for increased levels of fuel economy could have strongly adverse effects on traffic safety. The industry claims that requirements for large improvements in fleet fuel efficiency will push the new car fleet towards smaller vehicles, because only substantial reductions in average vehicle size will allow such improvements. Because the industry believes that small vehicles are less safe than large vehicles, they believe that traffic injuries and fatalities would increase as a result of stringent new fuel efficiency standards.

Finally, the industry has argued explicitly and strongly against the current CAFE standard and any attempts to increase the fuel economy targets in these standards. Their key arguments[34] are:

1. CAFE standards give some foreign manufacturers an unfair advantage over the U.S. manufacturers because imports have tended to be small, and small vehicles can more easily satisfy a given fuel economy goal than large vehicles, or a fleet composed of a mix of vehicle sizes. To the extent that the standards may push consumers toward vehicles they otherwise would not choose, the consumers might shift to imports while U.S. manufacturers lose profits and U.S. jobs are lost.
2. Fuel economy regulations ignore the reality that the market itself is the overwhelming factor in fleet fuel economy, and the market is determined primarily by fuel prices and perceived fuel availability -- not by regulations. If new, more stringent regulations force the manufacturers to build cars that consumers do not perceive as attractive, they will keep their old cars longer and put off new purchases -- slowing down improvements in the fuel economy of the total fleet and reducing American jobs and profits.

OTA Analysis and Conclusions

After examining these various arguments, OTA has come to the following conclusions:

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[34] See, for example, Statement of General Motors Corporation submitted to the Senate Subcommittee on Energy Regulation and Conservation, April 4, 1989, Washington, D.C.

A. Differing assumptions between antagonists. ***OTA concludes that at least part of the disagreement about achievable fuel efficiencies between the industry and the energy conservation community stems from different marketplace assumptions rather than technical disagreements.*** In many instances, the conservationists advocate fuel efficiency goals that they recognize would require, for successful implementation, a change in market incentives -- a tax on gasoline, rebate on fuel efficient models, etc. -- as well as more stringent efficiency standards. The industry, concerned primarily with consumer acceptance, generally discusses efficiency potential presuming that market incentives do not change, and thus arrives at more pessimistic conclusions.

B. Technical disagreements about long-term technologies. Regardless of different market assumptions, however, there remain strong technical disagreements about the availability, performance, cost, and other effects of fuel efficiency technologies.

Those disagreements about technologies that are not yet in mass production are extremely difficult -- in some cases, impossible -- to resolve at this time. However promising some advanced technologies may appear, their costs and performance will be highly uncertain until they are fully developed and in mass production and use. Similarly, the performances of "one of a kind" vehicle prototypes are instructive but far from conclusive in determining market acceptability. In a previous study, OTA concluded that increases in fuel efficiency to very high values "involve significant technical and economic risks," and an "increased risk that...insufficient development and testing will lead to poor on-the-road performance and/or product recalls."[35] In addition, OTA concluded in that study that the consumer costs of increased fuel efficiency, measured in dollars per gallon of gasoline saved, are quite speculative. For example, OTA's estimate of the consumer costs (in 1982 dollars) to achieve its 1995 new-car fuel efficiency targets varied from $.35/gallon saved to as high as $2.60/gallon saved.[36] These estimates range from economically attractive costs to costs that will be unacceptable to new car purchasers without large increases in gasoline prices.

It is, however, widely acknowledged in the automotive engineering community that there are a wealth of interesting automotive technologies under development whose successful introduction into the fleet would have significant positive impacts on fuel efficiency (See Table 3). Although the cost, performance, and market acceptability of each technology may individually be highly uncertain, it is fair to assert that *broad, aggressive development programs undertaken by the industry would stand a good chance of successfully moving some of these technologies into the fleet. It is also clear, however, that current market incentives do not encourage such programs.*

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35. Office of Technology Assessment, Increased Automobile Fuel Efficiency and Synthetic Fuels: Alternatives for Reducing Oil Imports, September 1982.
36. Ibid. The cost range reflects an assumed moderate shift towards smaller cars.

C. Fuel efficiency improvements from already-available technologies. Shorter term improvements involving technologies already in mass production are easier to evaluate. Based on our current analysis, ***OTA concludes that the new car fleet can be made significantly more efficient, without sacrificing performance, by adopting technologies that are already available in the marketplace and that have gained a measure of market acceptance.*** For example, comparisons among cars with virtually identical physical and performance characteristics but with different engine designs show that some of the newer engine designs available today -- such as General Motors' 4-valves-per-cylinder "Quad4" engine -- can boost fuel economy by about 20 percent on these models.[37] Ironically, these examples may be among only a very few where 4-valves-per-cylinder engines have been used primarily as an efficiency measure. In most cases where such engines have been introduced, they have replaced conventional (2-valves-per-cylinder) engines of similar displacement, with an ***increase in power rather than improved fuel efficiency.***

Assuming market conditions do not change substantially, the average fuel economy of the new car fleet is likely to be about 30 mpg (EPA) by 1995 -- and perhaps less. ***OTA believes that the 1995 new car fleet***

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[37] For example, the Pontiac Grand Am with the Quad4 obtains 32.2 mpg (EPA combined city/highway) versus 26.3 mpg for the virtually identical Chevy Beretta with conventional 2-valves-per-cylinder (and lower horsepower) engine. About half of the savings is due to a basic modernization of the engine, since the original engine is an older model; the other half is due to shifting from 6 cylinders to 4 and to reducing engine displacement, both allowed by the use of 4 valves per cylinder.

average could be close to 33 mpg if the industry began, right now, to plan to move available fuel efficiency technology into the fleet at a more rapid pace, and to use this technology in ways that emphasize improved fuel efficiency over higher performance. We calculate that this level of efficiency could be obtained without a performance loss or the need to move to smaller vehicles, at a cost that would be compensated for by fuel savings.[38] ***However, this "cost effectiveness" does not guarantee market acceptability, because other factors -- first cost of the vehicle, increased performance, driving "feel," and other factors -- may in sum be considerably more important than life cycle costs in influencing new car buying decisions.*** Thus, ***OTA doubts that the industry will pursue this course without a further economic or regulatory incentive to do so.*** Also, ***this goal is unlikely to be reached unless current trends towards increased performance and luxury (including increased use of 4-wheel drive) cease, and unless industry can -- and will -- comply with any new emission standards by choosing technologies that minimize any loss in fuel efficiency.***

Table 4 presents the technical means by which the automobile industry might achieve a 1995 new car fuel efficiency level of 33 mpg. OTA recognizes that there is disagreement about the actual performance that will be achieved by some of the technologies listed in Table 4. Some of these disagreements surfaced during a review of OTA draft

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[38] Assumptions: 1995 gasoline prices at \$1.10/gallon in 1987 dollars; discount rate of 10 percent; gasoline savings counted over only the first four years of driving.

Table 4. Attainable, Cost-Effective* Fuel Efficiency Technologies: Market Penetrations and Effects on Fuel Economy, 1995

1987 Base Fuel Economy 28.0 mpg

Technology	% F/E Gain	% Market Penetration 1987	% Penetration Increase 1987-1995	Fleet % F/E
Front-wheel drive	12.0	78.0	10	1.2
4-cylinder/4-valve**	10.0/5.0	5.0	40	3.0
Four-speed automatic/CVT	7.5	35.0	40	3.0
Electronic transmission control	1.5	2.0	80	1.2
Aerodynamics (C_D from 0.37 to 0.32)	3.4	N/A	100	3.4
Tires	0.5	N/A	100	0.5
Accessories	1.0	N/A	100	1.0
Engine improvements				
- Overhead cam engines	6.0	40.0	20	1.2
- Roller cams	1.5	40.0	40	0.6
- Low friction rings/pistons	1.5	N/A	80	1.2
- Throttle body fuel injection	3.0	31.0	10	0.3
- Multipoint fuel injection	7.0	45.0	10	0.7
Total				17.3

1995 Fuel Economy = 32.8 mpg
(with no change in performance and luxury)

N/A - Not applicable.

* Assumption: 1995 gasoline price = $1.10/gallon (1987$); 4-year time frame for fuel savings; 10% discount rate.

** The large fuel economy gain is associated with a 6-cylinder or 4-cylinder engine replacing an 8-cylinder or 6-cylinder (respectively) of equal power. The smaller gain is associated with engines of equal power and equal number of cylinders, but different displacement.

Source: Energy and Environmental Analysis Inc.

TABLE 4 - CONTINUED

Technology	Base Technology	Comment
Front-wheel drive	Rear-wheel drive	Assumes constant interior room
Aerodynamics II	15% drag reduction from 1987 base C_D = 0.37	Assumes drivetrain adjustment to capture benefit
Four-speed automatic	Three-speed automatic	Assumes no change in performance in lower 3 gears
Electronic transmission control	Mechanically controlled transmission	Assumes shift points optimized for FTP
Tires	Improved rubber formulation and design	Evolutionary improvements
Accessories	Two-speed accessory drives improved pumps, etc.	Combination of evolutionary improvements and new technology.
Four-cylinder/4-valve	Four-cylinder, 2-valve overhead cam engine	Engine downsized for constant performance
Overhead cam	Pushrod (overhead valve) engine	Engine downsized for constant performance
Roller cam follower	Sliding cam follower	Benefits up to 4% demonstrated
Low friction rings and pistons	Low tension rings and low mass pistons	Includes effects of better manufacturing

publications, and others during a workshop on fuel efficiency technologies held by OTA last September. In particular, some industry analysts claimed that the efficiency improvement estimates in Table 4 for front-wheel drive, four speed automatic transmissions, electronic transmission control, and fuel injection were too high -- for front-wheel drive, substantially too high. Also, some analysts claimed that there was some double-counting in the estimates.

Because fuel efficiency improvements have generally not been introduced one-at-a-time, and are rarely available as options, there are few opportunities to separate out their individual contributions to efficiency by a simple examination of the differing fuel efficiencies of otherwise identical vehicles. However, OTA is satisfied that its estimate of the aggregate effect of multiple technologies is accurate, and we believe the estimates of the individual technologies are accurate as well, although to a lesser degree of confidence. Checks of actual vehicles with similar physical characteristics (weight, performance) but different drivetrain combinations and differences in other efficiency-affecting characteristics have tended to confirm these estimates. However, if the OTA estimates do turn out to be somewhat optimistic, there are other technologies available, and opportunities for further market penetration of the technologies in Table 4, that would yield additional efficiency savings, though at added cost. The additional technologies include further weight reduction and aerodynamics, and intake valve control, which is on the verge of market introduction. Opportunities for further penetration of technologies listed in Table 4 include multipoint fuel injection (over throttle-body fuel injection), overhead cam engines, and 4-valves-per-cylinder engines. These initiatives would be more expensive than those of Table 4, but would be cost effective if the total lifecycle fuel savings were considered.[39]

Some additional savings might also be necessary to compensate for new safety measures. In particular, we expect a combination of air bags and anti skid brakes to add an average of 70-90 pounds to those vehicles on which they are installed, causing a fuel economy reduction of 1.3-2.0 percent per vehicle.[40]

D. Basic changes in the composition of the fleet. ***Very large increases in fleet fuel economy can be achieved if consumers are willing to accept lower performance and/or comfort levels.*** Wider use of diesel engines, for example, would offer substantial efficiency gains at the cost of reduced performance. Wider use of 5-speed manual transmissions also would substantially improve fuel efficiency, at lower cost and with improved performance compared to current automatic transmissions. And a shift to smaller vehicles would have a similar effect on fuel economy. For example, there are now a variety of small vehicles, with both gasoline and diesel engines, offering 4 or 5 passenger capacity and achieving fuel efficiencies on the order of 50 mpg or higher.[41] However, these vehicles and technologies have achieved only a very small market share in today's market (some are no longer available in the U.S. market), and a substantial shift in consumer preferences -- or a strong regulatory mandate -- would be required for them to obtain a large market share.

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[39] The average new car buyer is unlikely to take into account any savings past about 4 years or so unless it is certain that the added fuel efficiency of the vehicle will increase its sales price when he is ready to trade it in...a highly uncertain proposition.

[40] Energy and Environmental Analysis, Inc., contractor report to OTA, op.cit.

Shifts in the composition of the fleet could come from changes in consumer preferences associated with increased consciousness of environmental concerns (such as global warming) or renewed concerns about future fuel availability; or, instead, such changes could stem from government regulations. OTA notes that a recent analysis of the costs of creating a shift in the size mix of the fleet (absent market pressures to do so) concludes that such costs would be very high, up to several thousand dollars per vehicle.[42]

E. Safety effects of a shift to smaller cars. Safety *will* be an important concern if a substantial push towards improving fleet efficiency involves a significant decrease in vehicle size and weight -- a likely occurrence if fuel economy targets are set very high, considering that many of the "high mileage" vehicles in today's fleet are small and lightweight. Although accident statistics are complicated by several factors (for example, different rates of seat belt usage and different driver age distributions across vehicle size classes[43]), analyses of these statistics show that there is a strong positive relationship between vehicle size and safety[44] -- small cars usually are less safe than large cars. However, differences in crashworthiness among vehicles in the same size class demonstrate that ***careful design can compensate for small size in protecting a vehicle's occupants.***[45] The results of past design competitions sponsored by the Department of Transportation[46] similarly have shown that small cars can be made substantially safer. Nevertheless, because small cars are more vulnerable than large cars, all other things equal, strong government incentives towards fuel economy will need to pay careful attention to the safety issue.

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[41] For example, the GM Geo Metro (Sprint) (gasoline-powered, 4 passengers) at about 67 mpg and the Nissan Sentra diesel (4-5 passengers) at about 58 mpg. These are EPA 55/45 highway/city values. To get more realistic on-road values for gasoline-powered vehicles, EPA adjusts their laboratory values by multiplying the highway value by 0.78 and the city by 0.9. The Geo Metro would rate about 56 mpg using this adjustment. The Sentra diesel is no longer marketed in the United States.

[42] Difiglio, C., Duleep, K.G., and Greene, D.L., Cost Effectiveness of Future Fuel Economy Improvements, submitted to The Energy Journal, January 1989.

There is another side to the safety issue. In an OTA workshop on April 5, 1989, a representative of one of the three U.S. auto manufacturers noted that consumer concerns about safety tended to maintain the share of large cars in the vehicle fleet, because vehicle

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43. In its September 1982 report (op cit), OTA discusses in more detail the complicating factors and ambiguities in accident statistics compiled by the Fatal Accident Reporting System and others.
44. Ibid. This relationship is particularly strong in statistics on all accidents combined and in car-to-car collisions; it is not certain for single car collisions, although even in this class of accidents, subcompacts fare worse than all other size classes.
45. Ibid. Also, the results of the crash tests supported by the National Highway Traffic Safety Administration support this conclusion.
46. e.g., the Research Safety Vehicle Program.

purchasers perceived -- generally correctly -- that the large cars were safer. Certainly, many purchasers for whom a small, fuel-efficient car would be *functionally* acceptable, and in many ways preferable -- for example, workers seeking a car primarily for commuting, or parents buying a first car for their teenage child -- may instead buy a larger car for safety's sake. Yet the above-mentioned design competitions demonstrated that extremely safe small cars *could* be manufactured. Perhaps such purchasers would be willing to switch away from their full-sized sedans if they were offered an alternative small car with high safety credibility.

F. The Structure of Current and Future Fuel Economy Standards. OTA generally agrees with the domestic manufacturers (Ford and General Motors) that the current CAFE standards discriminate against manufacturers that produce a full line of vehicles, or that wish to concentrate on larger vehicles because that is where their marketing strength lies. Because the current standards establish a uniform mpg target, manufacturers producing larger vehicles, or a variety of vehicle sizes, must meet a more demanding *technological* standard than manufacturers who concentrate on smaller vehicles that are inherently more fuel efficient.

This would not harm the full line manufacturers if consumers valued fuel efficiency highly, since potential car buyers would tend to prefer vehicles whose efficiency-related design and equipment was more advanced. Under today's market conditions, however, ***attributes that are***

in conflict with fuel economy -- high performance, 4-wheel drive, luxury equipment, etc. -- often are more preferred than higher fuel economy. Manufacturers of small cars have fewer restrictions on incorporating these features into their models. Further, potential buyers may be willing to pay a smaller premium for higher fuel economy than this attribute costs the manufacturer, either making the higher efficiency vehicle less attractive or lowering profits by forcing the manufacturer to swallow the extra costs of efficiency measures.

A potential alternative to the current CAFE system is to set a fuel economy standard that is a function of the size mix of each manufacturer's fleet. A separate fuel economy value could be assigned to each vehicle size category, or the value could be a continuous function of vehicle interior volume.[47] The manufacturer's overall fleet standard could then be determined by calculating a sales-weighted standard based on his actual sales.

There are two important advantages of a standard of this type. First, it would avoid penalizing full-line manufacturers, because the severity of the standard would change with the size mix of the manufacturer's fleet. If structured properly, such a standard would establish more of a "level technological playing field," that is, it would make more uniform the technological challenge involved in complying with the standard. With such a standard, the competitiveness of the domestic industry should not suffer *if the industry can match its import competition on a technological basis*.

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[47] The advantage of a continuous function would be that manufacturer's would not then be tempted to boost the size of some of their vehicles just enough for them to qualify for the next largest size class -- and a less stringent standard.

Second, because each manufacturer's fleet standard would be based on the actual size mix of vehicles sold in that year, the role of changing market conditions -- at least to the extent that such conditions change consumer preferences for large vs. small cars -- would be reduced.

Congress must recognize, however, that this type of standard, or any other that we can think of, will not avoid distorting the market somewhat. The purpose of fuel economy standards is to force manufacturers to boost fuel efficiency more than the manufacturers believe the market alone warrants. Unless Congress is a better judge of future markets than the companies are, the standards are more likely than not to produce a new car fleet that is less attractive to consumers than the fleet would have been with no standards. The fleet will be some combination of more expensive, less powerful, less luxurious, and less stylish than it would otherwise have been.

This may be warranted if improved fuel efficiency has a value to the United States that is not factored into consumer car purchasing decisions -- for example, the national security benefits of reduced oil imports, or the benefits of lowering emissions of greenhouse gases -- and *if* the market distortions caused by standards do not overwhelm the benefits. For example, Congress must guard against standards that may make new cars so unattractive to consumers that they elect in large numbers to forego new vehicle purchases and instead perform heroic repairs to their older cars -- with subsequent loss of industry jobs and profits.[48] Also, Congress must consider the advisability of applying standards of similar technological challenge to light trucks, to prevent consumers from simply shifting their car purchases to light trucks and negating any benefits of the car standards (there are claims that some of this type of behavior is already occurring). Choosing the best *structure* for any new standard is an important component of this process. And selecting a *magnitude* for the standard -- a level of technological challenge -- is another. Too little challenge and the standard is not worth the political capital it will take to push it through Congress; too much challenge and the market distortions it creates could negate the benefits.

G. What One Potential Fuel Economy Standard Might Look Like. OTA has constructed a theoretical set of fuel economy standards based on the size-class mix of each manufacturer, to serve as an example of an alternative to the current uniform CAFE standard. This example illustrates a first, over-simplified step in the process of constructing a fuel economy standard that would establish a uniform technological challenge to each manufacturer. We note that policymakers who might prefer that a standard create incentives for a move to smaller vehicles may consider a uniform challenge to be undesirable.

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[48] Counterbalanced to some extent by increased jobs and profits in the auto repair sector.

The hypothetical standard establishes a target fuel economy for each size class that is a uniform percentage increase over the 1988 U.S. new car fleet fuel economy for that size class. The 1988 new car fleet fuel economy was 28.3 mpg. If, for example, policymakers would like the 1995 fleet average to approach 33 mpg -- OTA's "cost-effective achievable level," as defined above -- the target mpg improvement for each size class would be the same percentage improvement that the entire fleet would have to achieve, or

(33-28.3)*100/28.3 percent, or 16.6 percent.[49]

Table 5 presents the actual 1988 and required 1995 fuel efficiency for each size class, to achieve a 33 mpg fleet average. To allow maximum flexibility for the industry, each manufacturer would have a single company standard equal to the sales weighted average of the size class targets. In the extreme, a company that sold only minicompacts would have to achieve 43.3 mpg by 1995; a company that sold exclusively large cars would have to achieve 28.1 mpg by 1995.

Because there are substantial differences among automakers in the mix of vehicle sizes in their new car fleets, there will be substantial differences in the fuel economy target they will have to meet under this standard. Figure 10 shows the targets for each of 9 major manufacturers -- the three domestic makers, the 4 largest Japanese makers, 1 Korean

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[49] Because of roundoff errors in the market shares, the actual percentage used in our calculations to achieve 33 mpg for the fleet was 15.7 percent.

Table 5. A FUEL ECONOMY STANDARD BASED ON VEHICLE SIZE CLASS

Size class mpg goals based on a uniform scaleup from 1988 mpg levels

Size Class	1988 Market Share,%	1988 mpg,actual	1995 mpg,goal
minicompact	.8	37.4	43.3
subcompact	20.4	31.1	36.0
compact	39.2	29.6	34.2
midsize	24.9	26.8	31.0
large	12.9	24.3	28.1
2-seater	1.8	27.2	31.5
FLEET	100.0	28.3	33.0[1]

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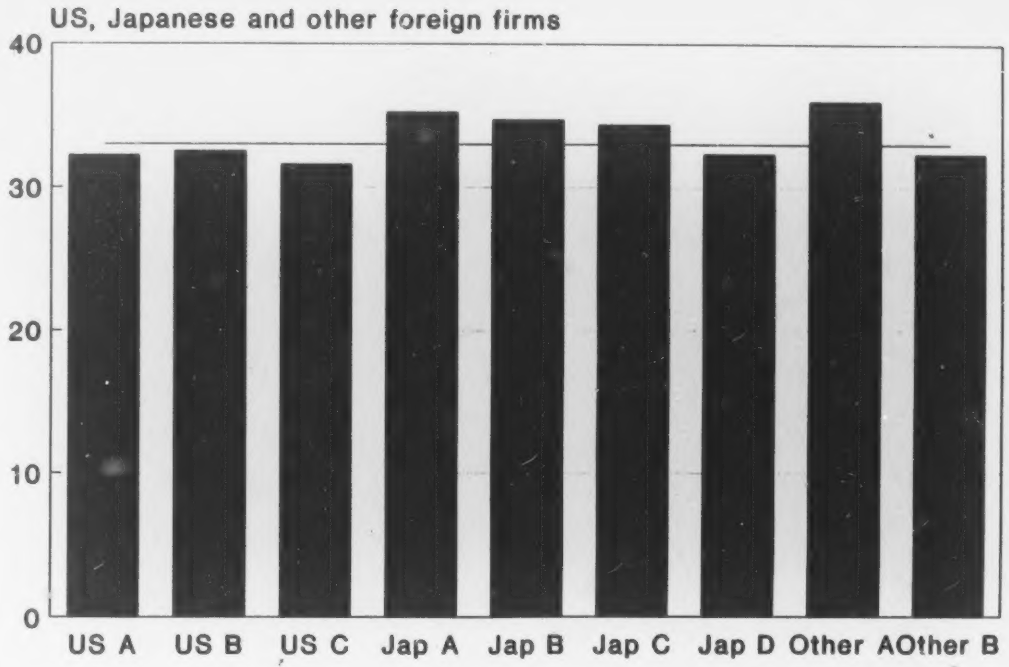
[1] Assumes that the size mix of the 1995 fleet is identical to that of the 1988 fleet.

Source: Office of Technology Assessment, based on Oak Ridge data

FIGURE 10.

Size Class Weighted Fuel Economy Targets
to reach fleet average of 33 MPG by 1995



SOURCE: OFFICE OF TECHNOLOGY ASSESSMENT, BASED ON OAK RIDGE DATA

maker, and 1 European maker -- assuming their sales mix in 1995 is identical to their 1988 mix.[50] The targets vary from 31.6 mpg for a domestic maker to 35.2 mpg for a Japanese company and 36.0 mpg for the Korean company.

A standard of this sort would directly address the criticism of the current CAFE standards, often brought by the domestic manufacturers, that they give an unfair advantage to the companies' Japanese competitors. In fact, the use of this approach to fuel economy standards provides a method to compare the fuel economies achieved by the various manufacturers in a manner that removes the effect of differences in the mix of size classes in their fleets. To do this, we devised a set of company-by-company size class mix-weighted standards to reach the *actual* fleet new car fuel economy in 1988 -- 28.3 mpg -- and compared these standards to the manufacturers' achieved fuel economies. Where the manufacturers' achieved values were above, below, or the same as the standards, the manufacturers' cars were better than, worse than, or the same as the industry average fuel economy adjusted to account for the sales mix of the fleet.

Figure 11 compares the company-by-company targets with the fuel economy values actually achieved in 1988. The figure shows that two of the three U.S. companies are within 1 percent of their targets, that is,

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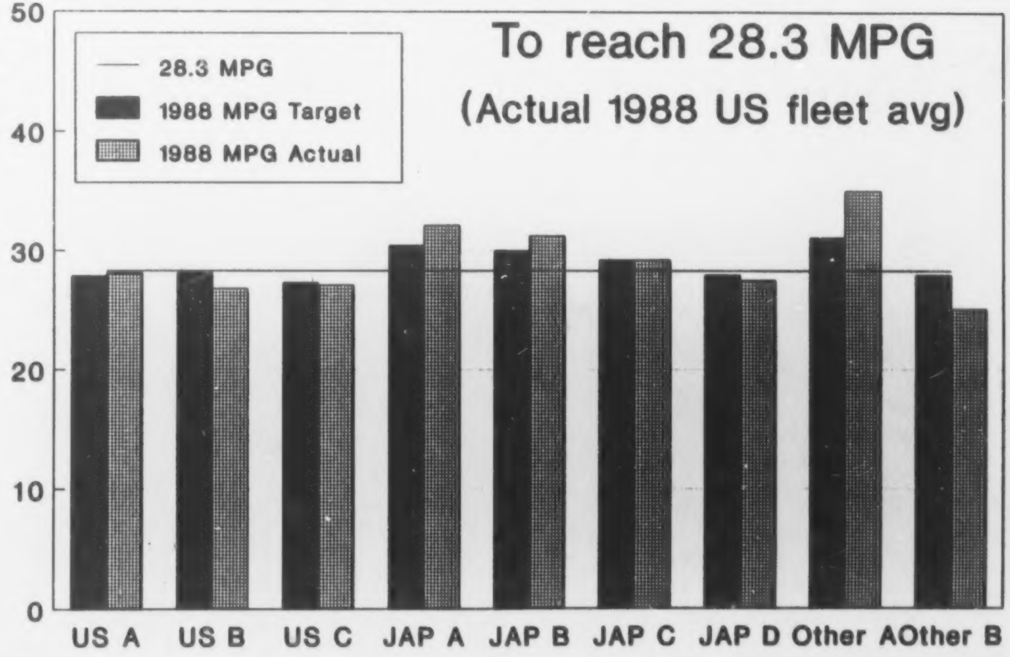
[50] Because some of the Japanese companies are entering the large car markets, their actual targets are likely to be below these values unless the larger cars are brought out under a different nameplate.

FIGURE 11.

Size Class Weighted Fuel Economy
Actuals vs Targets, 1988



SOURCE: OFFICE OF TECHNOLOGY ASSESSMENT, BASED ON OAK RIDGE DATA

their fleet fuel economies are near the industry average *taking into account the size class mix of their fleets*. Half of the Japanese companies are well over the industry average, with the other half at or near the average. And the European company is considerably under the average.

This comparison shows that ***differences in the size class mix of the domestic and import fleets account for much, though not all, of the differences in the fuel economies of these fleets***. For example, of an 18 percent difference in the fuel economy levels of an often-compared U.S. and Japanese manufacturer, approximately 12 percent -- two thirds -- of the difference is explained by the difference in size class mix.

We conclude by noting that the Congress has an extremely difficult decision to make concerning the future of the U.S. automobile and light duty truck fleets. If no further action is taken, the total fleet will continue to improve, primarily because of vehicle turnover. The new car fleet may also improve in efficiency, but this is uncertain because modest improvements in technology and design could easily be overcome by higher performance levels, design decisions favoring first cost over fuel economy, and other factors. At best, total fuel use of the light duty fleet might stay level, although a gradual rise may be more likely. In any event, increased oil use in other transportation sectors and declining U.S. domestic oil production will lead to increasing oil imports.

Increased Vehicle Efficiency: S. Plotkin

There are several mechanisms by which the new light duty fleet can become more efficient than the market would otherwise dictate. Currently available fuel efficiency technologies can be disseminated more rapidly and broadly into the fleet. Tradeoffs between fuel efficiency and performance and other vehicle attributes can shift more towards favoring fuel efficiency. Research on new technologies can increase, and auto makers can more rapidly move such technologies into the fleet once they become commercially available.

All of these mechanisms have risks, and these risks may vary considerably, depending not only on the particular efficiency mechanism but also on how much pressure is brought to bear on the mechanism and the means by which the pressure is exerted. It may be, for example, that a specific mpg standard such as the current CAFE or a size mix weighted standard might be most appropriate to move well known, low risk technologies into the fleet, but may be perceived as a very high risk method for accelerating the introduction of new, unproven technologies. Yet the fleet efficiencies achievable with currently available technologies are quite limited without substantial changes in the size makeup of the fleet and its performance, and accelerating the rate of development and commercialization of new technologies will be critical to any strategy that seeks to make large changes in fuel efficiency. In responding to a perceived need to make such changes, Congress may want to consider a range of strategies, including: mpg standards; economic incentives such as gasoline taxes, gas guzzler penalties, and rebates on ultra-high-efficiency vehicles; design competitions; joint industry/government research projects; and others.

As a final point in my testimony, I would like to stress that OTA is not recommending to the Congress that it choose a new CAFE (or other standard) of 33 mpg. In our view, Congress's choice whether or not to have any new standard at all, and if a new standard is desired, what its structure and magnitude should be, should depend on Congress's evaluation of a variety of factors, including the benefits of reducing oil imports and greenhouse gas emissions, the advisability of trying to combat market forces with regulations, and the potential risks and benefits to the auto industry and to consumers.

Senator BRYAN. Thank you very much, Mr. Plotkin.

We have been joined this morning by Senator Ford. Would you care to make an opening statement, Senator?

Senator FORD. No, sir. I just got a little shock here. You talked about increase in excise taxes and it bothers me just a little bit. I will get over that in a minute.

Senator BRYAN. We will have a nitroglycerin tablet available for all members.

Mr. Felrice, we will hear from you.

STATEMENT OF BARRY FELRICE, ASSOCIATE ADMINISTRATOR FOR RULEMAKING, NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

Mr. FELRICE. Thank you, Mr. Chairman. I appreciate the opportunity to testify before the subcommittee today.

As a result of the 1973–74 OPEC oil embargo, which led to gasoline shortages and significant increases in the cost of gasoline, the Congress enacted Title V of the Motor Vehicle Information and Cost Savings Act, which established fuel economy requirements for both passenger cars and light trucks.

The goal of the program was to arrive at a CAFE level for passenger cars of 27.5 miles per gallon by the 1985 model year. In setting that goal, Congress hoped to decrease the nation's dependence on foreign oil and at the same time encourage full employment in the domestic auto industry.

The statute also required the Secretary to set separate fuel economy standards for each year for light duty trucks, and to date we have set such light duty truck standards through the 1991 model year.

The fuel economy standard-setting responsibilities of the Department have been delegated to the National Highway Traffic Safety Administration. In amending fuel economy standards for cars and in setting standards for light trucks, the statute requires us to determine the maximum feasible average fuel economy level for the model year to which the standard applies.

In determining that level, we are required by the statute to consider four factors: technological feasibility, economic practicability, the effect of other Federal motor vehicle standards on fuel economy, and the need of the nation to conserve energy.

Although civil penalties are provided for manufacturers that fail to meet applicable standards, the statute also permits manufacturers to offset these penalties with accumulated past credits or estimated future credits for exceeding the standards, and there is a three year carryforward and carryback of such credits provided.

Through model year 1982, manufacturers increased their fuel economy rapidly and, due to strong market demand for fuel efficient cars, they exceeded the fuel economy standards during that period.

By model year 1983, however, there were indications that some manufacturers would be unable to meet the 27.5 miles per gallon statutory standard set for model year 1985, as declining fuel prices lessened consumers' interest in the most fuel-efficient cars.

This declining consumer demand for the most fuel-efficient models made compliance with the standards more difficult for those domestic manufacturers which offered a full range of passenger cars.

For model year 1986, both General Motors and Ford petitioned the Department for a reduction in the standard for that model year, stating that factors beyond their control, including lower gasoline prices and the resultant greater demand for both larger cars and higher performing cars, had reduced their fuel economy capability.

In response to these petitions and to other subsequent petitions, the Department set the CAFE standards at 26 miles per gallon for model years 1986 through 1988 and at 26.5 miles per gallon for model year 1989. But notwithstanding these lowered standards, the fuel economy of the total passenger car fleet continued to improve through model year 1988, the last year for which complete data are available, to the point where the fuel economy of that fleet in the past three years has exceeded the 27.5 miles per gallon statutory level.

And indeed, for model year 1988 the passenger car total fleet fuel economy was 28.7 miles per gallon.

Secretary Skinner is presently considering whether or not to reduce the passenger car CAFE standard of 27.5 miles per gallon for model year 1990 to some level between 26.5 and 27.5. Until this decision is made, statements on behalf of the Department will necessarily have to avoid positions that could be construed as indicating the Secretary's intent.

But having said this, I would like to assure this subcommittee that the Secretary is very mindful of the issues of energy conservation and the environment. The fuel efficiency of motor vehicles is one of a wide range of significant issues relating to the nation's energy policy and national economy that the Administration is currently reviewing.

The future role of CAFE standards in the nation's effort to conserve energy is now undergoing review as the Administration examines the effects of energy choices on both the economy and the world environment.

The questions of how to make further gains in fuel efficiency and whether such gains on balance constitute sound public policy will require a consideration of a multitude of factors: economic practicability and technological feasibility, possible tradeoffs regarding safety, comfort, and passenger carrying capacity, environmental effects, the effects on domestic employment, and effects on the U.S. economy, as well as of course on energy conservation.

When the Administration's review is completed, we will be in a better position to discuss the issues raised by the various legislative proposals to increase CAFE standards for future model years.

In this regard, we would note that the Administration currently has sufficient regulatory authority to amend the passenger car manufacturers and to set light truck standards at higher levels, and we strongly believe that the setting of any standard should be based on the feasibility of achieving that standard, considering the factors enumerated earlier.

In response to your specific questions, I would like to defer to the Department of Energy and EPA on the questions relating to trends in oil imports and the effects of gasoline use on carbon dioxide emissions.

You have also asked about the levels of passenger car fleet fuel economy expected by the year 2000 if there is no change in Federal fuel economy standards, and also about the range of levels that are achievable by that year. At this point we have not conducted such a long-range estimate of this type.

However, there have been studies, as you have heard earlier, by the Office of Technology Assessment and the Department of Energy which do contain some preliminary estimates. But we believe that all the factors that were enumerated earlier have not been fully considered yet in those studies and that more analysis will be needed before we can reasonably say what levels are achievable through additional economic and regulatory measures.

You also asked about the effects of the CAFE standards on the competitiveness of the domestic auto manufacturers and the prospects for improving the structure of the CAFE program. We agree with OTA that the current CAFE program is unquestionably more difficult as presently structured for the domestic manufacturers than for foreign manufacturers that produce only compact and subcompact vehicles.

Whether the uneven effects of the law can be corrected and what effects such corrections might have on fuel economy are matters that are currently under careful review within the Administration at this time. I hope that this review can be completed quickly and that we will soon be able to recommend any legislative changes that seem advisable.

Mr. Chairman, that concludes my remarks and I would be glad to answer any questions you may have.

[The following information was subsequently received for the record:]

QUESTIONS OF SENATOR BRYAN AND THE ANSWERS THERETO

Q1. The views of the Administration on the issue of fuel economy standards are, of course, important to the Congress as we work on the policy. Please describe the policymaking process on the CAFE issue. What is the role of your agency, and what other offices are playing a role? What is the status of consideration of the issue, and when can we expect a statement from the Administration?

A1. We agree that this is an important issue and we would add that it is a complex one as well. We believe that the setting of fuel economy standards must be based on an analysis of several issues including economic practicability; technological feasibility; possible tradeoffs regarding safety, comfort, passenger carrying capacity, and performance; environmental effects; impacts on domestic employment; and effects on the U.S. economy as well as energy conservation. The Administration is currently considering these issues as it develops policies on fuel economy and possible revisions to the CAFE statute. Clearly, with a program with such broad impacts, several Federal agencies are involved, including, in addition to the Department of Transportation (DOT), the Department of Energy and the Environmental Protection Agency. While the issues are complex, we hope to be able to discuss the Administration's policy views on CAFE within the next few months.

In addition, DOT itself is examining these issues in a more detailed manner in consideration of possible future rulemaking under the existing CAFE statute.

Q2. Please state whether your testimony, both at the Consumer Subcommittee's May 2 hearing and before the Energy Committee in April, was reviewed by any White House Office in addition to OMB. Was your testimony before either committee altered in any way by either OMB or any other White House Office?

A2. Other than the Office of Management and Budget (OMB), I know of no White House office review of my testimony before your Subcommittee or that of the Managing Director, Howard Smolkin, at the April 4, 1989, hearing before the Subcommittee on Energy Regulation and Conservation of the Senate Energy and Natural Resources Committee. OMB comments were very minor, altering neither the intent nor the spirit of DOT's testimony.

Q3. Please comment on the auto companies' testimony at the Subcommittee's hearing to the effect that a relatively small percentage of worldwide CO_2 is contributed by U.S. vehicles. Does this fact mean that vehicle fuel economy should not be a policy option for dealing with global warming?

A3. This question raises several significant issues which this agency cannot address. One is whether any single program in any single country, such as the fuel economy program in this country, could make a meaningful contribution to dealing with greenhouse gases. Another is whether the significance of such a contribution should be measured against the gross output of carbon dioxide or against the net increase of that gas in the atmosphere. Since NHTSA lacks the expertise to resolve these issues, it defers to EPA.

Q4. Testimony from both the Department of Energy and the EPA indicates that additional automobile fuel economy is technologically feasible between now and 1995. The Department of Transportation did not address that issue. Please state, if you can, what specific mileage figure you believe is feasible, for both cars and light trucks, by 1995 without sacrificing performance or altering the vehicle size mix?

A4. In setting CAFE standards, DOT is currently required by statute to consider three factors in addition to technological feasibility. These are economic practicability, the effect of other Federal standards on fuel economy, and the need of the nation to conserve energy. These other factors introduce issues of possible tradeoffs among such considerations as safety, passenger-carrying capacity, performance, environmental effects, impacts on domestic employment, and effects on the U. S. economy. We have never set standards based solely upon a single factor such as technology, and we believe that CAFE estimates based solely on technological feasibility can be misleading. For example, the use of diesel engines, which falls into this category, provides a 20-25 percent fuel economy improvement over equivalent size gasoline engines. However, under prevailing market conditions, there is no consumer demand for such engines. Thus, looking solely at certain technological improvements can lead to the conclusion that fuel economy gains are feasible, when that may not be so in any meaningful sense. As we noted in our response to Question 1, we have not yet completed our studies which will form the basis for DOT statements on the level of future CAFE standards.

Q5. Please state whether you believe that the CAFE standards in effect over the past 11 years have been a factor in the increased fuel efficiency of the fleet.

A5. The agency believes that CAFE standards may have been one factor contributing to the improved fuel efficiency of passenger automobiles and light trucks. However, there were other dramatic changes in the 1970's and early 1980's which clearly affected the supply of and demand for fuel-efficient cars--gasoline price increases, restrictions on fuel availability, and the competitive pressure of Japanese imports. It is extremely difficult to determine what effect CAFE standards, as opposed to other factors, had on the overall improvement.

Senator **BRYAN**. Thank you, Mr. Felrice.

Dr. Berg.

STATEMENT OF DR. JOHN BERG, ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY, ACCOMPANIED BY DR. CARMEN DIFIGLIO, DEPUTY DIRECTOR, OFFICE OF POLICY INTEGRATION; AND ALAN STREB, DEPUTY ASSISTANT SECRETARY FOR CONSERVATION

Dr. **BERG**. Thank you very much, Mr. Chairman.

I have a statement which I would like to submit for the record and, if I may, summarize it for you.

Senator **BRYAN**. We would appreciate that. Thank you.

Dr. **BERG**. Thank you very much.

I am accompanied today by Dr. Carmen Difiglio, Deputy Director of the Office of Policy Integration, and Mr. Alan Streb, Deputy Assistant Secretary for Conservation.

I appreciate this opportunity to appear before you today to discuss our potential to improve automobile fuel efficiency and its impact upon reducing the risk of global climate change.

Our Nation's increasing dependence on imported petroleum is a serious problem that must be addressed by a balanced, integrated energy policy. Secretary Watkins is committed to the development of an integrated national energy strategy that addresses energy security concerns in a way that also enhances our economic efficiency and safeguards the environment.

The U.S. transportation sector accounts for one-third of U.S. emissions of carbon dioxide, the most significant greenhouse gas. Secretary Watkins has said he considers the threat of greenhouse gas-induced global climate change a very serious matter. The Department of Energy is and will continue to be one of the lead agencies in reducing the remaining scientific uncertainties in this area. In the interim, there are a number of strategies which should be pursued because they both reduce the risk of global climate change and can be justified on their own merits, such as the development of more efficient combustion technologies and of alternative energy sources.

The Department of Energy has studied and continues to investigate the potential for cost-effective efficiency improvements for alternative transportation fuels and for the mitigation of the environmental consequences of petroleum use.

For example, the Department has a vigorous program of research, over $9 million requested in 1990, aimed at reducing the cost of production of biomass-based fuels.

Corporate average fuel economy standards send a signal to the Nation that we are serious about energy efficiency. Between now and the year 2000, additional automobile fuel economy is technologically feasible. The fuel efficiency of cars can be improved by increasing the use of existing technologies.

These technologies include front-wheel drive, overhead camshafts, roller cams, multi-point fuel injection, four-valve four-cylinder and six-cylinder engines, electronic transmission control, aerodynamics, reduced accessory drag and improved lubricants and tires.

But technological feasibility is only one of a number of critical factors that confront auto manufacturers in their planning for future product lines. Consumer demand, energy prices, competitive forces, safety issues, and environmental regulations are among other highly uncertain factors that must be considered.

The Department has a continuous program of research into better materials, improved components, and systems designs which will increase energy use efficiency and make alternative fuel use both reliable and economically attractive.

For example, in the transportation program the first phase of the design and procurement of improved ceramic components for the automotive gas turbine have been completed through collaborative efforts with the ceramic industry. These components, when developed, will enable the operation of small gas turbine engines at temperatures in excess of 2500 degrees Fahrenheit, thereby providing potential efficiency improvements of more than 30 percent over today's technology.

Higher transportation fuel efficiency can be a part of a national strategy to reduce our dependence upon imported oil. We recognize that there will be differences in how to achieve this improved fuel efficiency and the appropriate governmental role in this regard.

The Department of Transportation has the legal authority to establish Corporate Average Fuel Economy standards. The Department of Energy's role is to provide information and advice on the technological feasibility of higher CAFE standards and on the Nation's energy conservation needs. The Department of Transportation considers DOE's comments, along with several other important factors, in the broader context of establishing standards that meet Congressionally mandated criteria.

In summary, we are in the process of reviewing energy conservation policy options as a part of our preparatory work for development of an integrated national energy strategy. The role of improved fuel efficiency must be placed in the context of a broader energy strategy that also increases domestic energy supply and the substitution of more reliable and diverse energy sources and the mitigation of environmental effects.

The Secretary of Energy is committed to the development of this integrated national strategy and has called for an increased national attention to conservation.

Mr. Chairman, we appreciate the opportunity to appear before you today and gain your advice on these matters. I would be happy to answer any questions which you or the subcommittee may have.

Thank you.

[The statement and questions and answers follow:]

STATEMENT OF DR. JOHN R. BERG, ASSISTANT SECRETARY, CONSERVATION AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY

I am happy to have the opportunity to appear before this Subcommittee today to discuss our potential to improve automobile fuel efficiency and its impact on reducing the risk of global climate change.

Our Nation's increasing dependence on imported petroleum is a serious problem that must be addressed by a balanced, integrated energy policy. Oil consumption is increasing, and domestic production is in decline. The transportation sector's near total dependence on large volumes of petroleum plays a key role in oil demand and supply policy, and substantially effects the environment.

The U.S. transportation sector accounts for one third of U.S. emissions of carbon dioxide, the most significant greenhouse gas. Secretary Watkins has said he considers the threat of greenhouse gas-induced global climate change a very serious matter. The Department of Energy is and will continue to be one of the lead agencies in reducing the very substantial remaining scientific uncertainties in this area.

In the interim, there are a number of strategies which should be pursued if they can be justified on their own merits, such as the development of more efficient combustion technologies and of alternative energy sources and they may reduce any potential effects of global climate change.

The Energy Information Administration forecasts a 10 percent increase in gasoline use by the year 2000 if new vehicle efficiencies remain at their present level. This would lead to a increase in CO_2 *emissions. Transportation fuel efficiency improvements would tend to dampen that increase.*

The Department of Energy has studied and continues to investigate the potential for further cost-effective efficiency improvements, for alternative transportation fuels, and for mitigation of the environmental consequences of petroleum use. Secretary Watkins is committed to the development of an integrated national energy strategy that addresses energy security concerns in a way that also enhances our economic efficiency and safeguards the environment.

Corporate average fuel economy standards send a signal to the Nation that we are serious about energy efficiency. Over the past 15 years, automobiles and light truck efficiency improvements have made a substantial contribution to moderating demand for oil.

In 1973, the average new car sold in the United States traveled only 14 miles on a gallon of gasoline. By 1987 the average new car sold in the U.S. achieved a fuel efficiency of more than 28 miles per gallon. This extraordinary accomplishment of American industry placed U.S. automobiles on a par with those being made in Europe and Japan, where fuel prices are two to three times what American motorists pay.

Clearly, we have accomplished a great deal since the energy sector disruptions of the 1970s. While the trend in fuel economy for cars actually purchased has been consistently upward, and has significantly exceeded CAFE standards despite historically low gasoline prices, data for 1987 and 1988, and preliminary estimates for the first three months of 1989 sales, indicate a leveling of fuel economy progress.

The Department of Transportation has the statutory authority to establish CAFE standards. In carrying out his responsibilities in setting CAFE standards, the Secretary of Transportation is required to consult with the Department of Energy. The Department provides information and advice on the technological feasibility of higher CAFE standards and on the Nation's energy conservation needs. The Secretary of Transportation must also consider other factors in making his determination of maximum feasible average fuel economy. These other factors are economic practicability and the effect of other Federal motor vehicle standards on fuel economy.

The Subcommittee has requested DOE's views on the current structure of the CAFE standards. As discussed above, under the current structure, the Department of Transportation has the statutory authority to establish CAFE standards and consults with DOE regarding the technological feasibility and the Nation's energy conservation needs. DOE believes that this structure is appropriate.

As to the effect of an increase of CAFE standards on domestic industry competitiveness and the U.S. job market, DOE has not specifically examined this issue. In its comments on CAFE rulemakings, DOE has restricted its analysis to technological feasibility and energy conservation effects.

Between now and the year 2000, additional automobile fuel economy is technologically feasible. But technological feasibility is only one of a number of critical factors that confront auto manufacturers in their planning for future product lines. Consumer demand, energy prices, competitive forces, safety issues, and environmental regulations are among the other, highly uncertain factors that must be considered.

Among the technologies that can be used to improve fuel efficiency are front-wheel drive, overhead camshafts, roller cams, multi-point fuel injection, 4-valve four-and six-cylinder engines, electronic transmission control, aerodynamics, reduced accessory drag and improved lubricants and tires.

The Energy Information Administration's 1989 extrapolation to the year 2000 forecast fuel economy approaching 34 MPG for new passenger cars and 25 MPG for light duty trucks (20 percent improvements over current levels). These projections do not assume higher mandatory fuel economy standards. The combined on the road fleet MPG for all passenger cars and light duty trucks in 2000 is projected by EIA to be 24 MPG. Other projections based on DOE's Motor Fuel Consumption Model suggest that lower levels of efficiency are likely if current trends continue. The lower forecast of this model reflects announced changes in product introduction dates, fuel prices in 2000 that are lower ($1.27/gal. in 1988 dollars) than EIA's forecast price (of $1.32), and lower estimates of diesel engine penetration.

The Subcommittee requested DOE to address the issue of achievable levels of fuel economy with maximum use of current technology, and the costs associated with these levels. The Department is presently engaged in a study of fuel economy potential for 2000. At this time we have very preliminary estimates of maximum technologically achievable fuel economy, but we do not have estimates of the total cost. We would emphasize that the cost issue is extremely important and should not be considered separately from the technologically achievable potential. Our preliminary estimates indicate that the maximum technologically feasible level of fuel economy in 2000 is in the range of 35 to 40 MPG for passenger cars, and 30 to 35 MPG for light trucks.

These ranges assume maximum use of available technology, regardless of cost-effectiveness. The light truck estimates, in particular, assume substantial diesel engine use. We have assumed no shifts in vehicle sales to smaller cars or trucks, nor any decrease in performance. The width of the range is a result of uncertainty about the actual utilization of some technologies, and the exact efficiency benefits of others, such as four-valve engines.

The transportation sector plays a crucial role in U.S. petroleum dependence. Oil use by the transportation sector in 1988 exceeded 10 MBD, up more than 2 percent from 1987, and almost 20 percent higher than in 1973. Transportation oil use alone exceeded U.S. production of petroleum in 1988 by 750,000 barrels per day.

Total U.S. oil use increased by half a million barrels per day last year and continues to grow. Domestic crude oil production has declined from a 1985 high of 9 MBD to 8.1 MBD in 1988. The combined effects of increased consumption and declining production raised oil imports for 1988 to 7.2 MBD. Imports from OPEC countries have supplied a large fraction of that increase.

From a low of 1.8 MBD in 1985, imports from OPEC countries grew to 3.4 MBD last year. We are on a course that will lead in the early 1990s to historically high levels of oil consumption and imports reaching 50 percent of national requirements.

Increased oil demand in the United States and around the world, combined with growing cooperation among oil producers, has produced a rebound in oil prices. Near the end of 1987 crude oil prices were near $10 per barrel. Last week, the spot market price rose above $24 per barrel. However, predicting future oil prices is a tricky business, as we all know from past experience.

Because of its near-total reliance on oil, the transportation sector accounts for one-third of U.S. emissions of carbon dioxide. Cars and light trucks represent 58 percent of transportation sector emissions. The EIA forecasts a 10 percent increase in gasoline use if new vehicle efficiencies remain at their current level of 26.1 MPG for passenger vehicles and light trucks combined. It would require a 20 percent improvement in new car and light truck MPG by 2000 to hold CO_2 emissions constant or cause a slight decrease.

Other strategies to reduce CO_2 emissions currently under study by DOE and EPA include the introduction and use of clean-burning alternative transportation fuels. Because of its lower carbon *content, compressed natural gas produces 30 percent less CO_2 than petroleum. If produced from biomass, alcohol fuels such as ethanol or methanol result in no net emissions of atmospheric CO_2. DOE has a vigorous program of research aimed at reducing the cost of production of these biomass-based fuels.*

CONCLUSION

Past achievements in increased domestic energy production, fuel substitution, and greater energy efficiency have brought us the benefits of lower prices and abundant oil supplies. But shrinking domestic production, expanding demand, and growing import dependency require renewed attention to conservation.

The transportation sector, because of its reliance on petroleum-based fuels and because of the size of its oil consumption, is a key element in addressing the energy security problem. Higher transportation fuel efficiency can be a part of a national strategy to mitigate rising oil import dependence.

The Administration is in the process of reviewing oil conservation policy options as part of its preparatory work for development of a national energy strategy, which should aim for a balance of energy efficiency improvements, increased domestic energy supply, substitution of more reliable and diverse energy sources, and mitigation of environmental effects. The Secretary of Energy is committed to the development of this integrated national energy strategy and has called for increased national attention to conservation.

This concludes my prepared remarks. I would be happy to entertain any questions that the Committee may have.

QUESTIONS FROM SENATOR BRYAN

Question 1: The views of the Administration on the issue of fuel economy standards are, of course, important to the Congress as we work on the policy. Please describe the policy-making process on the CAFE issue. What is the role of your agency, and what other offices are playing a role? What is the status of consideration of the issue, and when can we expect a statement from the Administration?

Answer: The Department of Transportation has the statutory authority to establish CAFE standards. In carrying out his responsibilities in setting CAFE standards, the Secretary of Transportation is required to consult with the Department of Energy. The Department of Energy provides information and advice on the technological feasibility of CAFE standards and on the Nation's energy conservation needs. The Secretary of Transportation must also consider other factors in making his determination of maximum feasible average fuel economy. These other factors are economic practicability and the effect of other Federal motor vehicle standards on fuel economy. The Department of Energy, apart from its role in the CAFE rulemaking process, also has an important role in determining fuel economy policies. As you know, Secretary Watkins is committed to the development of a sound national energy policy coupled to an integrated strategy to carry out that policy. One of the issues that policy will address is the growing dependence of our Nation on imported oil. The transportation sector plays a crucial role in U.S. petroleum dependence, and increased energy efficiency and conservation in the transportation sector will be key elements that will be addressed in that strategy.

Question 2: Please state whether your testimony, both at the Consumer Subcommittee's May 2 hearing and before the Energy Committee in April, was reviewed by any White House office in addition to OMB. Was your testimony before either committee altered in any way by either OMB or any other White House office?

Answer: The Department's testimonies prepared for the April and May CAFE hearings were reviewed using normal procedures by OMB. It was also reviewed by White House staff who had no comments. The Departments of Transportation and Commerce and the Environmental Protection Agency also had an opportunity to comment. No other offices were involved in this review process.

DOE's draft testimonies were not significantly altered as a result of this review process.

Question 3: Please comment on the auto companies' testimony at the Subcommittee's hearing to the effect that a relatively small percentage of worldwide CO_2 is contributed by U.S. vehicles. Does this fact mean that vehicle fuel economy should not be a policy option for dealing with global warming?

Answer: U.S. transportation currently contributes about one-third of the energy-related CO_2 produced in the U.S. or about 7% of the energy-related CO_2 in the world. U.S. passenger automobiles and light trucks (those subject to CAFE standards) account for almost two-thirds of this or over 4% of worldwide energy-related CO_2 emissions.

Even though autos, individually and as a class, emit only a small percentage of worldwide CO_2, we should not underestimate their importance. Our country, in cooperation with other nations, may have to rely on many small responses if net greenhouse gas emissions are to be reduced.

Currently, the Department of Energy is actively working with other agencies and internationally to reduce the scientific uncertainties associated with the greenhouse effect. In the interim, there are a number of actions that both the Government and the private sector should undertake that would reduce emissions of CO_2 that are justified without primary reference to global climate change. The Department is pursuing this type of response in its present programs.

Question 4: Testimony from both the Department of Energy and the EPA indicates that additional automobile fuel economy is technologically feasible between now and 1995. The Department of Transportation did not address that issue. Please state, if you can, what specific mileage figure you believe is feasible, for both cars and light trucks, by 1995 without sacrificing performance or altering the vehicle size mix.

Answer: We have used the following four factors to determine a "feasible" fuel economy level for cars and light trucks for MY 1995.

1) Proven capability of technologies to improve fuel economy;
2) regulatory requirements (emission and safety);
3) consumer choices for automobiles and light trucks; and
4) manufacturers' near-term product plans.

Based on this definition, we have estimated that a reasonable range of automobile fuel economy is 29-31 mpg by MY 1995. Similarly, we have estimated that a reasonable range of light truck fuel economy is 22-23 mpg by MY 1995.

These estimates do not fully reflect the requirements of the President's clean-air plan. We are now evaluating the impact that proposed tighter emission requirements will have on this estimated range.

It should be noted that many factors, including consumer choice, are the ultimate determinates of actual fuel economy. In the recent past, we have witnessed consumer trends towards use of light trucks as personal vehicles, towards increased performance as expressed in horsepower-to-weight ratios or measured vehicle acceleration, and towards heavier, more luxurious vehicles - both cars and trucks. We have also seen increased use of fuel economy technologies which have prevented these other trends from jeopardizing our fuel economy progress. These potentially offsetting forces - consumer preferences and continued use of more advanced technologies are a source of uncertainty in estimating future fuel economy.

Question 5: Please state whether you believe that the CAFE standards in effect over the past 11 years have been a factor in the increased fuel efficiency of the fleet.

Answer: We have not been able to analytically prove one way or the other whether CAFE standards over the past 11 years have been a factor to improve U.S. automobile fuel efficiency. However, certain observations can be made.

U.S. new car fuel efficiency is approximately equal to that in Japan and Germany despite substantially higher fuel prices in those countries. This may be partially a result of U.S. CAFE requirements. Or, it may reflect the considerable rise in U.S. gasoline prices during the 1970's, and the increased competitiveness of the world automobile industry.

Recent econometric research has suggested that automobile manufacturers that were constrained by CAFE requirements behaved differently from companies that were not. The fuel economy of cars produced by companies that were not constrained by CAFE standards appeared to respond to fuel prices more than the fuel economy of cars produced by companies that were constrained by CAFE standards. This would suggest that CAFE standards were having an impact on the companies they directly affected.

We also have reviewed work by others which found that CAFE standards did not have an impact on U.S. automobile fuel economy (e.g. Robert Crandall in Regulating the Automobile, the Brookings Institution). We do not regard the econometric results, one way or another, to be conclusive enough to reach an analytic conclusion.

Senator **Bryan**. Thank you very much, Dr. Berg.

Mr. Morgenstern.

STATEMENT OF RICHARD D. MORGENSTERN, DIRECTOR, OFFICE OF POLICY ANALYSIS, ENVIRONMENTAL PROTECTION AGENCY

Mr. **Morgenstern**. Thank you, Mr. Chairman. I appreciate the opportunity to appear before this committee to discuss EPA's activities concerning global warming, with particular reference to the fuel efficiency of automobiles.

I ask that my prepared remarks be submitted and I will summarize the key points.

In response to a request from the Senate Environment committee in late 1986, EPA conducted a major study on policy options to limit greenhouse gas emissions. We were asked in the so-called stabilizing report to study the need for and implications of significant changes in energy policy, including energy efficiency and development of alternatives to fossil fuels, reduction in the use of CFC's, ways to reduce other greenhouse gases, such as methane and nitrous oxide, as well as the potential for and effects of reducing deforestation.

A draft of this report, which is over 700 pages, has been completed. It is currently under extensive review. On March 17th, EPA Administrator Reilly discussed this report before the Environment Committee.

He discussed at length the report's methodology and design, its limitations and uncertainties, and a whole range of other issues. Rather than review all that this morning, I refer you to his March 17th statement.

Briefly today, I will note a few points on global warming and then turn directly to the issues on CAFE. Greenhouse gases, such as water vapor, CO_2, nitrous oxide, methane, which naturally occur in the atmosphere serve as a virtual thermal blanket around the Earth.

This blanket traps some of the infrared radiation which is emitted back from the Earth's surface, thereby leading to warming. If there were no greenhouse gases, it is estimated that the Earth would be approximately 30 degrees Celsius colder.

Although there is uncertainty regarding the rate and magnitude of the warming, there is a scientific consensus that if the concentrations of greenhouse gases are increased significantly above current levels, then atmospheric temperatures will rise.

The atmospheric concentration of CO_2 has increased approximately 25 percent in the past 100 years, in part due to fossil fuel combustion and industrial and agricultural activities. The National Academy study, the 1979 study, has estimated that the effect of doubling of CO_2 concentrations would in the most likely case eventually lead to a global warming of 1.5 to 4.5 degrees Celsius.

There are many human activities which serve as sources for emissions of these gases. Converting all of the greenhouse gases to the common denominator of warming contribution allows comparison of the overall impact of various source categories.

Energy production and use accounts for almost 60 percent of the current global contribution to greenhouse warming. CFC's are the next largest category at 17 percent, followed by agriculture at 14 and deforestation and other land modifications at 9 percent.

Within the energy category, transportation accounts for about a third of the energy impact on warming or about 20 percent of the total warming contribution. Within the U.S., transportation provides a similar share of total warming.

Automobiles are the dominant component of transportation energy, over 60 percent of transportation energy use in the industrialized economies of the OECD. Although detailed and reliable data are not available for non-OECD countries, it is believed they account for a similar, although probably slightly smaller, share in these areas.

Policies directed at improving automobile efficiency can make a significant impact on greenhouse gas emissions in the U.S. and globally. These options were given considerable attention in our draft report.

Options for fuel economy improvements were not based on EPA analysis, but rather they were drawn from published studies, some of the same studies referenced by the previous speakers. In the major policy cases examined in our draft report, a new global car average—this is for new cars—of 40 miles per gallon was assumed for the year 2000, with an average fleet economy, fleet MPG, of 50 by the year 2025.

In a more aggressive policy scenario, we looked at a case where new cars would average 50 in the year 2000 and would rise to 65 miles per gallon in the year 2025.

In developing these scenarios, we reviewed the previously referenced studies by OTA, DOE, the International Energy Agency, and private consultants. These studies, as suggested, all indicate that significant improvements in fuel economy are technically achievable. Some of these studies address the economics of achieving these improvements.

In our work, the modified fleet average fuel economies were directly input to a model without explicit linkage to the particular mix of policies needed to achieve that result. The modeling effort was meant to illustrate the effects on global warming of major policy-related improvements in efficiency in automobile fuel use.

A number of possible technical and policy options exist for achieving these improvements. These would include fuel taxes, gas guzzler taxes, the funding of research and development, as well as direct energy efficiency standards as in the case of CAFE.

I note that many of the studies cited as a basis for the fuel assumptions used in the EPA draft report have been criticized by automobile manufacturers. Concerns raised include the cost, safety, consumer preference, and other emissions concerns. All these concerns must be addressed in detail in the context of developing policies to promote better standards.

We at EPA believe, and our report emphasizes, that global cooperation will be essential to effectively reduce emissions. No single country or source will contribute more than a fraction of the emissions that contribute to global warming.

Although the U.S. may have the highest per capita emissions, our share of total emissions, global emissions, is only about one-fifth. The EEC plus Japan contribute about another fifth, and the Soviet Union and East Bloc countries contribute still another fifth.

In this context, I am pleased to report that there is a good deal of activity under way internationally on the global warming issue. EPA and other Federal agencies are participating actively in a UNEP and World Meteorological Organization-sponsored activity, and we expect that some of the work in our EPA study will find application in that international environment.

In summary, I believe that the results of our analysis to date indicate that improvements in automobile fuel economy may be a significant factor in reducing the potential for global warming.

Concerns have been raised about the practicality and about the costs of promoting a rapid increase in fuel economy too rapidly. These concerns must be analyzed in detail. EPA will be placing a high priority on this detailed analysis in the coming months, in cooperation with other agencies and with industry.

Finally, Mr. Chairman, I would like to add for the record that in reviewing my written testimony we discovered a typographical error on page 4 which relates to the emission reduction effects of increased miles per gallon. The corrected version has been submitted to the committee staff.

Thank you.

[The statement and questions and answers follow:]

TESTIMONY OF
RICHARD D. MORGENSTERN
DIRECTOR, OFFICE OF POLICY ANALYSIS
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
CONSUMER SUBCOMMITTEE
COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION
UNITED STATES SENATE

May 2, 1989

Mr. Chairman and Members of the Subcommittee, I am pleased to have this opportunity to discuss with you the issues of global climate warming and automobile fuel economy. My remarks are based primarily on EPA's work over the last year in evaluating options to reduce greenhouse gas emissions on a global basis. This evaluation was carried out in response to a request from Congress. Our report on this subject is now undergoing a formal public review process.

Greenhouse gases, such as water vapor, carbon dioxide, nitrous oxide, methane, and others, occur naturally in the atmosphere. They serve as a figurative thermal blanket, allowing solar radiation to pass through the atmosphere and strike the earth's surface, while absorbing some of the infrared radiation emitted back from the surface. This selective absorption of long-wave radiation warms the atmosphere and gives us our present climate. If there were no greenhouse gases it is estimated that the earth would be approximately 30 degrees colder. If the concentrations of greenhouse gases are increased, the atmospheric temperature will increase.

There is scientific consensus that increases in atmospheric concentrations of greenhouse gases will result in climate change. The atmospheric concentration of carbon dioxide has increased approximately 25 percent since about 1860, in part due to fossil fuel combustion and industrial and agricultural activities. A panel of the National Academy of Sciences estimated in 1979 that an effective doubling of the concentration of carbon dioxide in the atmosphere could eventually lead to a global warming of 1.5 to 4.5 degrees C. The Academy analysis also recognizes a 50% probability that the actual temperature result could be above or below this range. Considerable uncertainty exists with regard not only to the timing, but also to the ultimate magnitude of any global warming. In addition, there is great uncertainty about how climate variability and regional climate patterns may change.

Improving fuel economy is one of many specific options discussed in the Environmental Protection Agency's draft report to Congress entitled, Policy Options for Stabilizing Global Climate. The Study identified options that had the technical capability to affect emissions of greenhouse gases. It did not fully analyze the costs or other economic and social implications of the identified technical options. On March 17 of this year, Administrator Reilly discussed this report before the Subcommittee on Environmental Protection of the Committee on Environment and Public Works.1/ He discussed at length the report's methodology and design, its limitations and

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1/ See printed hearing, Serial No. 101-31, pp. 32-51, Committee on Environment and Public Works uncertainties, the technological and policy options, as well as an overview of the report's findings.

THE IMPORTANCE OF TRANSPORTATION

There are many human activities which serve as sources for emissions of greenhouse gases. Converting all of the greenhouse gas emissions to the "common denominator" of potential warming contribution allows comparison of the overall impact of various source categories. Using this metric, energy production and use in all its applications accounts for almost 60% of the current global contribution to potential greenhouse warming. Within the energy category, transportation energy use accounts for about a third of the energy impact on warming or 20% of the possible total warming contribution. Within the U.S., transportation provides a similar share of potential total warming.

Automobiles are the dominant component of transportation energy - over 60% of transportation energy use in the industrialized market economies of the OECD. Although detailed and reliable energy use data are not readily available for non-OECD countries, it is believed that automobiles also account for a major though smaller share of transportation energy use in these countries.

Technically feasible improvements in automobile energy efficiency could have an impact on greenhouse gas emissions in the U.S. and globally. Beyond technical capability, a number of factors need to be considered, including economic practicality, safety, passenger carrying capacity and performance, trade and economic competitiveness implications, as well as implications for CO2 and other emissions affecting the environment. Using 1985 vehicle miles travelled as a basis, we have estimated that a 1 mile per gallon improvement in on road fleet average fuel economy would have reduced emissions of CO_2 by about 9 million metric tons (expressed as tons of carbon). Globally, a 1 mile per gallon efficiency improvement would have reduced CO_2 emissions by over 40-50 million metric tons (C). On a percentage basis, these reductions associated with the 1 mile per gallon improvement on a global basis are roughly equal to 1% CO2 and about 1/2% for all greenhouse gases.

In the absence of policy action to improve fuel economy, EPA's analysis still projects some improvement, with new light duty vehicle fleet averages in the U.S. rising to up to 30 miles per gallon by the year 2000. This increase in fuel economy is consistent with recent analyses by the Department of Energy and others. However, given the experience of the last few years, if world oil prices remain relatively low, we would caution that even the modest efficiency improvements in EPA's reference cases may be optimistic.

Options for fuel economy improvements were given considerable attention in the draft report. These fuel economy improvements were not based on EPA analysis, but rather drawn from other published studies. In the major policy cases examined in the draft report, a new U.S. car fleet average fuel economy of about 40 miles per gallon was assumed by the year 2000. In a more aggressive policy scenario, EPA assumed that new car fleet average fuel economy would reach 50 miles per gallon by the year 2000, and that global fleet average fuel economy would reach 65 miles per gallon in 2025. This assumption resulted in additional reductions in global transportation energy use by the year 2025.

In developing scenarios, we reviewed studies by the Department of Energy, the Office of Technology Assessment, the International Energy Agency, and private consultants. These studies all suggest that significant improvements in fuel economy are technically achievable. Some of the studies address the economics.

In EPA scenarios, the modified fleet average fuel economies were directly input to the model without explicit linkage to the particular mix of policies needed to achieve this result. The modeling effort was meant to illustrate the potential effects on global warming of major improvements in efficiency in automobile fuel use. A number of possible technical and policy options exist for achieving fuel economy improvements. These include fuel taxes, gas guzzler taxes and sipper rebates, and funding of research and development, as well as direct energy efficiency standards such as CAFE.

In addition, improvements in efficiency of fuel use in other transportation components, such as highway freight, shipping and aircraft, appear to be technically possible and potentially useful. Several alternative fuels for automobiles and other transportation show promise in reducing greenhouse gas emissions as well as some other pollutant emissions of concern.

NEXT STEPS

In the immediate future, EPA expects that response to the extensive review comments already received on our draft report will improve our understanding of the quality and uncertainty of assumptions used in the analysis. We hope that the draft policy options report will produce considerable additional comment by expert reviewers. The formal review process now underway will include comments by a distinguished panel of experts assembled by the EPA Science Advisory Board as well as detailed comments from other Federal Agencies, including the Department of Energy, the Department of Transportation and the Department of Commerce. The draft report has also been made available to other interested parties who wish to comment. As these comments are evaluated over the next several weeks, the report will be updated as appropriate.

EPA is also beginning some more detailed evaluations of several key technology options identified in our report. These analyses will improve our understanding of the costs of technology and the effectiveness of available policy options for implementing technological solutions. These studies will include detailed interaction with other Federal Agencies as well as international organizations and other relevant experts.

Other issues of major importance including improvement of our understanding of environmental processes and impacts and continuing scientific assessment of uncertainties involved in all such analyses will also be evaluated.

Global cooperation will be essential to effectively reduce greenhouse gas emissions. No single country or source will contribute more than a fraction of the greenhouse gases that may contribute to global climate change. Any overall solution to the climate change problem will require cooperation of many countries and reductions in many sources. As a result, a great deal of activity is underway internationally on the global warming issue. EPA and other U.S. Agencies are participating actively in the Intergovernmental Panel on Climate change which has been established under the auspices of the United Nations Environment Program and the World Meteorological Organization. One of the working groups under this Panel will be collecting and evaluating information on available policy options from all parties. In support on the Panel's activities and the concerns of its members the Organization for Economic Cooperation and Development is sponsoring a number of activities designed to facilitate sharing and comparison of information on both science and policy options among countries and organizations interested in climate change.

EPA is participating actively in these international endeavors, and expects to receive review and comment on our current and future work on technology and policy options. In addition, information developed in other countries will be identified and incorporated into EPA's ongoing analyses as appropriate.

In summary, I believe that the results of EPA's analysis to date indicate that improvements in automobile fuel economy may one of the significant factors in reducing the potential for global warming. However, many concerns have been raised about the practicality and possible negative effects of policies to mandate rapid fuel economy improvement. These concerns should be analyzed in detail, as should a range of alternative policy approaches for achieving fuel economy improvements. EPA will be placing a high priority on this more detailed analysis in the coming months, in cooperation with industry, other federal Agencies and international activities.

United States
Environmental Protection
Agency

External Affairs (A-100AE)
Washington DC 20460

EPA

Legislative Analysis

JUN 19 1989

Honorable Richard H. Bryan
Chairman, Consumer Subcommittee
Committee on Commerce, Science and Transportation
United States Senate
Washington, D.C. 20510

Dear Mr. Chairman:

Enclosed, for insertion in the hearing record, are EPA's responses to questions which you forwarded on behalf of the Subcommittee following the May 2 hearing on global warming and CAFE standards.

Please feel free to contact us if we can be of any further assistance.

Sincerely yours,

A. Henry Schilling
Director, Office of
Legislative Analysis

Enclosure

1. The views of the Administration on the issue of fuel economy standards are, of course, important to the Congress as we work on the policy. What is the role of your Agency, and what other Offices are playing a role? What is the status of consideration of the issue, and when can we expect a statement from the Administration?

Answer: There are several levels of policy consideration on the CAFE issue. Within the context of the existing program, the Department of Transportation is required to make a regulatory decision for each model year regarding whether to continue or modify (up or down) the existing CAFE standard. EPA has participated in this process by providing comments to the DOT prior to these decisions through the normal comment process. In addition, the Administrator has communicated directly and personally with Secretary Skinner that continued improvements in automobile fuel economy should be considered as a possible action to reduce the sources of global climate warming. We have been noted that recent trends have indicated the possibility of declining fleet average fuel economy in the U.S. and have urged the DOT to carefully consider whether or not, in the light of all relevant factors, it would be desirable to use existing authority to reverse this trend.

The question of whether the administration should propose or endorse new legislation to promote major increases in fuel economy over the next decade or more is much broader than CAFE standards. As I indicated in my testimony, EPA's recent draft report on Policy Options for Stabilizing Global Climate, has provided a preliminary assessment showing potential benefits in terms of reducing the rate of warming which might be achieved through improvements in end-use energy efficiency, including automobile fuel economy improvements globally. Other Agencies also testified that significant improvements in new fleet fuel economy are technologically achievable in the next decade and could have other benefits such as energy security. However, in determining reasonable policy goals, other factors such as cost and economic practicality, trade and economic competitiveness implications, and potential tradeoffs with safety, carrying capacity and performance, must also be evaluated.

We believe that further analysis of alternative policy approaches to mandating or encouraging such improvements is warranted. Problems with the structure of the existing CAFE standards were noted by several witness at your hearing. Alternative ways of applying efficiency standards should be considered. Also, other policy approaches such as carbon emission fees, gasoline taxes, gas guzzler taxes, and other financial incentives and disincentives, either as alternatives or in combination with efficiency standards may or may not be more effective approaches to achieving policy goals.

Finally, any policy decisions taken on automobile fuel economy must be evaluated in the context of broader national energy and economic policy goals and the international scope of the global warming problem. It is important that fuel economy policy action be consistent with and supportive of these broad objectives.

All of these issues are being considered and debated by all of the relevant Agencies of the Federal government within the Domestic Policy Council and its subgroups, and within the U.S. working group supporting our involvement in the Intergovernmental Panel on Climate Change. Other Agencies involved in these discussions include the Departments of State, Commerce, Treasury, Agriculture and Interior, and the Office of Management and Budget.

We appreciate the concern of the Congress about the need for prompt action on proposed CAFE standards legislation, but it may take some time before all of the complex issues mentioned above can be evaluated and the Administration can develop a position regarding the level and timing of fuel economy improvements desired and the appropriate mix of policy actions need to achieve this goal.

2. Please state whether your testimony, both at the consumer subcommittee's May 2 hearing and before the energy committee in April, was reviewed by any white house office in addition to OMB. Was your testimony before either committee altered in any way by either OMB or any other White House Office?

Answer: It is standard procedure in this administration (and previous administrations) that the Office of Management and Budget (OMB) coordinates comments by all relevant Federal Agencies on Congressional testimony and resolves any policy differences which emerge between individual Agencies. EPA's draft testimony on both of the occasions you mentioned was reviewed by OMB staff and through OMB, other Federal Agencies. In both cases substantive comments were received from OMB, including suggested deletions of portions of the testimony and alternative wording elsewhere. In each case, the suggestions were discussed with OMB staff, and most of the suggested changes were incorporated in my testimony as a result. It is entirely appropriate for OMB to perform this coordinating role when one or more individual Agencies are testifying on matters of broad policy affecting the interests of many Federal Agencies.

3. Please comment on the auto companies' testimony at the subcommittee's hearing to the effect that a relatively small percentage of worldwide CO_2 is contributed by U.S. vehicles.

Does this fact mean that vehicle fuel economy should not be a policy option for dealing with global warming?

Answer: It is correct that U.S. vehicles contribute a relatively small percentage of global CO_2 emissions. EPA has estimated that light duty vehicle use accounts for about 16% of U.S. CO_2 emissions which is equivalent to about 4% of global emissions. The U.S. electric utility industry has made a similar argument based on the fact that its energy use contributes only about 8% of global CO_2 emissions. In terms of total CO_2 emissions, these are nevertheless large sources which by themselves are larger that total emissions from most countries in the world. It is important to recognize, as EPA's draft report emphasizes, that achieving significant reductions in global CO2 emissions would require coordinated policy actions affecting many different source categories and many different countries. Any single source category in any single country will necessarily be a small percentage of total global CO2 emissions. Because the total is made up of such small percentages, no single country or source industry can legitimately claim that it is not part of the global warming problem. We believe that vehicle fuel economy improvements are an inherent part of any reasonable overall solution to global warming.

If a full consideration of all of the relevant factors were to show that the climate change, and other environmental, economic and energy security benefits that would directly accrue to the U.S. would justify the imposition of increased automobile fuel economy measures, it would be in the U.S. interest to take such action, even if other nations did not follow. In addition, there may be ways to coordinate such U.S. policy action in such a case with the international negotiation process to encourage other major emitting nations to adopt similar measures. Finally, it is especially true for automobiles that technology is fairly standardized worldwide. Imposing fully cost-beneficial increased fuel economy measures in the U.S. - the world's largest market for automobiles - would result in improvements in other countries as they adjust production to meet the U.S. demand.

4. Testimony from both the Department of Energy and the EPA indicates that additional fuel economy is technologically feasable between now and 1995. The Department of Transportation did not address that issue. Please state, if you can what mileage figure you believe is feasible, for both cars and light trucks, by 1995 without sacrificing performance or altering the vehicle size mix?

Answer: EPA has not directly analyzed this issue but rather has drawn on analyses carried out by other organizations. Both DOE and OTA presented estimates of technologically achievable fleet average levels of approximately 35 mpg by 1995, with slightly lower levels for light trucks. Based on our available information, these levels seem reasonable.

5. Please state whether you believe that the CAFE standards in effect over the past 11 years have been a factor in the increased fuel efficiency of the fleet.

Answer: I believe strongly that CAFE standards have been a factor in fuel efficiency improvements over the last decade. How important they have been relative to other factors, such as fuel price increases and shortages in the 1970's, is very difficult to quantify.

Senator **Bryan**. Thank you very much, Mr. Morgenstern.

Mr. Felrice, let me begin the questions with you. As you know, I sent a letter to Secretary Skinner urging him to retain the 27.5 miles per gallon standard which is provided by law absent a waiver.

The New York Times reports on April 15th that the Secretary has decided to maintain the 27.5 miles standard, but that it is currently under review at the White House. We are also told that General Motors has corresponded with the Secretary and perhaps the White House as well, indicating their request that the waiver be approved.

Could you enlighten us on the accuracy of those reports?

Mr. **Felrice**. I wish I could, Mr. Chairman. But until the Secretary's decision is finally and formally publicly announced, I am really not at liberty to say what his recommendation was.

Senator **Bryan**. Can I take it that you are neither confirming nor denying the report?

Mr. **Felrice**. Correct.

It is true, though, that General Motors did write the Secretary within the last few weeks, again urging him to lower the standard to 26.5 miles per gallon.

Senator **Bryan**. Do you have any indication, Mr. Felrice, when the decision might be made publicly as to what the decision is on the waiver request?

Mr. **Felrice**. I am optimistic that that decision will be made very soon, and by "very soon," I would guess within the next week or two.

Senator **Bryan**. That is good, all right.

Mr. Plotkin, I would like to ask you a couple of questions. You suggested that maybe we ought to approach this fuel economy standard a little differently and take it, as I gather, by individual company, requiring each company which may have a different product mix—particularly, it is argued that the Japanese inherently have an advantage because many of their manufacturers do not have a large automobile inventory.

How would you achieve this?

Mr. **Plotkin**. Well, there are a number of ways to do it. I illustrated one of them, and I think it is perhaps the most simple way, in my testimony, and that is to look at the mix of vehicles in each EPA size class and assign a—first look at the whole fleet and assign an efficiency to each set of vehicles, and then look at the individual companies and see what their mix actually is, and calculate a company standard based on that mix of vehicles.

You could also do it by looking at the average interior volume of the vehicles they sell. That may have an advantage over the size class thing for one reason, and that is, if you pass a law based on the size class, I think you can almost bet that all of the vehicles that are slightly to the down side of the next higher size class will expand a little bit so they get the benefit of the lower standard for that size class.

I think you would rather have a smooth curve so you do not force distortions in the market.

Senator **Bryan**. Mr. Plotkin, you can provide some more detailed information to the staff on that, I presume?

Mr. **Plotkin**. Yes, I can.

Senator **Bryan**. Let me ask you another question. It is frequently argued by the automobile manufacturers that, why should they be the first one to bite the bullet, that the total emissions from automobiles represent only a small portion of the total CO_2 emissions in this country or worldwide.

Is there any one big target or are we talking really that each of the sources represent a substantial contributing factor and there is no one real major target out there that we are looking at, and if indeed we are going to make progress on this that everybody has to step up to the plate and it is not unreasonable to ask the automobile industry to cooperate with us in achieving a higher level of fuel efficiency?

Mr. **Plotkin**. That is a pretty complicated question, Senator.

First of all, I certainly agree that by focusing on one industry only you make a mistake, that there are so many important source of CO_2 that you want to look at energy conservation across the board.

But I also believe that the automobiles represent a good target for you, for two reasons: first, because they represent a very substantial part of energy use; and second, because they are an industry that is a little easier, I believe, for Congress to legislate energy improvement efficiency on.

If you look at industry in general, you have so many different sources that it is virtually impossible to have any reasonable standard for efficiency. But in this particular case you have a fairly finely tuned industry, producing one product, and I think it is much more reasonable to have a standard on a uniform or a size class-related standard for this industry than for a lot of other industries.

Senator **Bryan**. Let me be a little more specific. I have a chart here from the World Resources Report, 1988–89. If I am reading that correctly, it suggests that emissions from gasoline alone in the United States exceeds the total CO_2 emissions from Latin America, Japan—individually now; I am not talking about combining those two—Middle East, West Germany, South and Southeast Asia, United Kingdom, Africa, and France.

Am I reading that report correctly? And if I am, do you agree with that report?

Mr. **Plotkin**. Senator, I do not know. I mean, those numbers do not sound surprising to me, but I have not seen that chart and I do not really know.

Senator **Bryan**. Let me ask Dr. Berg and Mr. Morgenstern. That is the report on the easel there. Do you agree with the data? Am I reading the data correctly?

Is my assumption in interpreting it that gasoline CO_2 emissions in the United States equal the combined total in each of those others that are listed—Latin America, Japan, Middle East, West Germany, South and Southeast Asia, United Kingdom, Africa, and France?

If that is correct, that suggests that gasoline emissions is a substantial part of the problem and it is appropriate for the Congress to look at this as an important area for improvements.

Mr. Morgenstern. Mr. Chairman, by my reading you are in fact reading the chart correctly, that the United States, as I mentioned in my testimony, accounts for about a fifth of overall emissions in gasoline as a share, as indicated on this chart, and it does exceed, as indicated here, the emissions, all emissions of these other countries.

Senator Gore. Mr. Chairman, if I might, if you could yield for just a note.

Senator Bryan. Yes.

Senator Gore. The figures are very interesting. They are for 1985, and the new vehicle standards for this last year are lower than for the year measured here. So the chart is probably worse, the current figure.

Senator Bryan. Thank you very much.

Senator Gorton, I yield to you.

Senator Gorton. Mr. Felrice, you indicated to the Chairman that the Secretary is likely to make his decision with respect to 1990 models in the next week or two. On a similar subject, is the Secretary—and this might be directed to Dr. Berg and Mr. Morgenstern as well—does the Secretary have any plan to make recommendations with respect to new legislation in connection with CAFE standards, the kind of proposal which Senator Metzenbaum has made, for example?

Mr. Felrice. I think the answer to that question is a definite yes. The Department of Transportation, along with EPA and DOE and other agencies, is currently considering the whole question of CAFE standards and energy conservation and the role of CAFE in the energy conservation issue.

When that consideration is complete, which I hope will be shortly, I would imagine that the Department would either take a position on existing legislation or recommend legislation on its own. So the answer is yes.

Senator Gorton. Well, you have said shortly. From the perspective of our planning for legislation in this area, can you give us any time frame within which we might expect such a recommendation?

Mr. Felrice. Well, I certainly appreciate the subcommittee's concern. I wish I could give you a definite date. But we are, I imagine, talking perhaps a few months rather than a few weeks, as is the case for the 1990 decision.

Senator Gorton. Mr. Plotkin, I found interesting your proposal that perhaps we should treat each manufacturer differently with respect to their fleet average standards, which presumably would reflect the mix of vehicles which they are producing at the present time.

I would like you to explain, however, what particular social goal or utility that kind of change would have? It seems to me that the two purposes for having CAFE standards are to lower the use of energy for various trade and economic purposes and lower the adverse environmental impact of energy use.

If we allow the greatest leniency to those manufacturers who have done the least to meet either of those goals, what purpose are we serving?

Mr. Plotkin. Senator Gorton, the way you characterize the question, we should penalize manufacturers who have done the least, and I guess I would agree. But I would respond by saying it is not clear that the manufacturers with a full line of vehicles have necessarily done the least.

At least from a technological standpoint, if a fleet of small vehicles gets 32 miles per gallon, that may not represent as important a technological effect as a fleet of larger vehicles getting 28 or 29.

I think the advantage of a size class-related standard or any standard based on the size of the vehicle is that it protects the domestic industry from a real problem down the line, and that problem is this: that if it becomes quite difficult to reach a particular standard for them, but if the Japanese, for example, have no trouble at all because they are building smaller vehicles, then the Japanese have total flexibility to structure their fleet.

That is, they can increase the power of their vehicles and the domestics cannot in the future. So if that happens, then you will see a shift of market share away from the domestic industry towards imports.

Senator GORTON. You do not feel that one of the goals of these standards should be consciously to encourage a down-sizing of passenger automobiles and small trucks?

Mr. PLOTKIN. If Congress wants that, then they should not go to a standard like this. The only reason to go to a standard like this is if Congress decides that it does not want to enforce a shift of this kind.

Senator GORTON. What is your view with respect to appropriate standards for small trucks?

Mr. PLOTKIN. My view is that a small car should have to attain a higher efficiency than a large car, unless there is a desire——

Senator GORTON. No, no. I am shifting to a different subject.

Mr. PLOTKIN. I am sorry.

Senator GORTON. I wanted your views on small trucks.

Mr. PLOTKIN. Oh, small trucks. I am sorry, sir.

I think it is a mistake to ratchet down the automobile fleet and not do the same to small trucks, because people are using small trucks as passenger vehicles. So that I would try to find a standard for small trucks which represented about the same level of technological challenge to the makers of those trucks as we are imposing on automobiles.

Senator GORTON. Dr. Berg, does the Department of Energy view with concern the increasing dependence of the United States on foreign oil?

Dr. BERG. Yes, sir.

Senator GORTON. And if so, does it feel that these CAFE standards have any implication or relationship to that problem?

Dr. BERG. Yes, the Department does have a very strong interest in the fact that we are importing oil. Regarding the CAFE standards, we are not prepared to take a position on that until this whole thing has been sorted through. The Department's whole program, in energy conservation, and thrust has been that any method and means which is economically feasible that reduces the energy use and increases or improves efficiency, should be done.

Senator GORTON. Is the Department likely to have a broad-range set of recommendations, including but by no means limited to CAFE standards, designed to meet those goals?

Dr. **Berg**. The national energy security plan that we are talking about is being worked on at the present time, and we are scheduled to have the first draft, with input from people on the Hill, as well as industry, as well as government agencies, prepared by the end of August or the first part of September.

Senator **Gorton**. Thank you.

Thank you, Mr. Chairman.

Senator **Bryan**. Thank you very much, Senator Gorton.

Senator Gore.

Senator **Gore**. Thank you, Mr. Chairman.

Mr. Felrice, I had the opportunity to chair this subcommittee in the last Congress, and at that time I requested from the Department of Transportation documents which I have reason to believe indicate that the staff at the Department recommended against the decision that was made by the Secretary to lower the standard.

Secretary Burnley at that time refused to provide those documents. I asked for the legal basis of the refusal and was not given any.

This year on the 5th of January, while still before the transition to the 101st Congress, I again requested some legal basis to support the Department of Transportation's denial of our request. I do not think there is a legal basis.

I have still—here it is May the 2nd. That request was issued by the subcommittee on January the 5th. Why have we not been given the courtesy of a response? What is the legal basis of the prior refusal? And will you provide the documents?

Mr. **Felrice**. Not being an attorney, Senator Gore, I do not know what the legal basis might be. And I also am unsure as to why you have not gotten a response to that letter.

But I can tell you I will return to the Department and bring this to the Secretary's attention and have a response for you.

Senator **Gore**. All right. I will look forward to that response. And as I say, I really do not think there is a legal basis, and I think that—I suspect that my sources are right, and that is that the experts in the Department who really had the information and who really did the work did advise against the decision that the Secretary made, and that the Secretary may well have rejected the technical advice and what was in the best interests of the environment and the country, and for purely political reasons overruled the expert advice given him by his own staff.

But I will await your further response on that point.

Mr. Plotkin, I listened carefully to the discussions between you and the Chairman and the Ranking Member about the idea of changing the structure of the CAFE standards toward either a size class standard or a volume standard. The legislation which I introduced on the first day of this Congress takes the approach of a percentage increase in efficiencies already attained, and one of the reasons for that is to answer the concerns of domestic manufacturers.

It is open to the argument that has been made, that you referred earlier, about its effect on those who have gone the farthest so far.

I still think it is the best approach. But I have an open mind about the idea that has arisen in the discussions here this morning.

Our object with these standards is to force new technology to move along faster than the market might otherwise introduce it.

If you have fluctuations in the price of fuel and experience indicates that there is a tremendous elasticity in consumer demand for different classes of vehicles depending upon the absolute price of fuel and, perhaps more importantly, the perceived direction of the price that fuel is headed in, then the ability of the standard to accomplish its result is really affected by changes in the price of fuel.

Is it essentially for that reason that you raise this possibility of a size class standard or a volume-based standard?

Mr. PLOTKIN. No, it is not, Senator. First of all, I guess I have to argue with you a little bit that people will choose very different vehicles depending on fuel price. One interesting thing—and one of the figures in our testimony shows that, but I think it is certainly not news to anybody—is that the interior volume of the U.S. fleet has been absolutely rock steady over the past decade or so. People simply have not been all that willing to change the size of their vehicles.

Now, there is one factor, I think——

Senator GORE. Is it an illusion that people bought more small cars when gasoline prices shot up? Is that just an illusion?

Mr. PLOTKIN. No, it is not an illusion.

Senator GORE. It did happen?

Mr. PLOTKIN. It did happen, but I would argue——

Senator GORE. They chose small cars when the gasoline prices went up, did they?

Mr. PLOTKIN. I would argue that the reasons may have been because of the prices and they may have been because of the concerns of the buyers about availability and the possibility of rationing.

I think it is very important to look at how the market shifted once people became convinced, not that prices were going down, but that there would be plenty of gasoline.

Senator GORE. Well, and then you have to adjust the prices for overall inflation and all of that.

Mr. PLOTKIN. Yes.

Senator GORE. But that is the point I was trying to make when I pointed to the direction of the prices, the perceived direction of the prices. And it is appropriate to add to that the perceived future availability of the fuel.

I would like to pursue it, but I am running out of time, so I will just leave it by saying that I do have an open mind on volume-based standards. I do still prefer the approach that I have recommended.

Just briefly before the time runs out altogether, Mr. Morgenstern, I wish you would take back to the EPA my compliments to Mr. Reilly on what I think has been an outstanding performance on his part thus far in his tenure. I wish there were other appointees having responsibility over environmental policy in this Administration who approached his commitment and expertise. There are not. But I think he is doing an outstanding job.

Just finally a question, if I can squeeze it in here. I think that the global warming issue will quickly become perceived as a national security issue, threatening interests that have traditionally been described in terms of military threats, because global warming and the destruction of the ozone layer will, if we do not make dramatic changes, soon have impacts that will be seen as national security threats.

When we approach national security questions in the military arena, we consider not just gradual, incremental changes, but drastic measures. Has EPA in looking at the future considered the possibility that we may at some time not that distant in the future have to require a shift in the transportation sector to an entirely different fuel altogether, with not just incremental change, but a very massive, drastic change in the structure of our entire transportation fleet?

Every time we try to do it with these little incremental shifts here and there, we run into this obstacle and that obstacle. Are we not headed toward the time when we are going to have to just take an entirely different approach?

Mr. MORGENSTERN. It is a big question, Senator. I guess the answer is yes, there are some active discussions going on within the Agency about alternative fuels. Not all of them would have favorable impacts on greenhouse gas emissions, as I believe you are aware.

But I think over the long term we certainly are looking at alternatives.

Senator GORE. Well, there is no point in doing it if it does not have a favorable impact on solving the problem. But I mean, I just think we have got to really start thinking in very different and even radical terms.

Thank you, Mr. Chairman.

Senator BRYAN. Thank you very much, Senator Gore.

Senator Breaux.

Senator BREAUX. Thank you, Mr. Chairman.

I would say to my colleague Al Gore about the question of whether global warming is perceived to be a threat to national security, I do not know if that makes a difference in this Administration and the last Administration, I would say to Al, because President Reagan transmitted a finding to the Congress that imported oil posed a threat to our national security.

That was the finding of this Administration, and the recommendation was that we do not do anything about it. So if they make a determination that global warming is a threat to the national security and do the same thing that they have done with regard to the importing of oil in this country, nothing is going to happen.

So even elevating it to a national security threat in some instances is meaningless as far as getting any activity done. That is a whole other story.

Let me ask—we were talking about the CAFE standards. I really have a feeling that in the not too distant future, in fact probably pretty close, dealing with the clean air bill and everything else, that we are going to be talking about, instead of just increasing CAFE standards, the use of alternative fuels as a methodology of reducing the problems with global warming and CO_2 emissions.

Can any of you gentlemen tell me how the people you represent feel about the use of methanol and ethanol and other alternative fuels as a means of reducing the CO_2 emissions, as opposed to just trying to gradually increase by half a mile per gallon the fuel efficiency standards?

Is that not really where we ultimately are going to be going, instead of trying to squeak out a half a mile more or a tenth of a mile more? Are we not going to be requiring cities in their mass transit to be using methanol and ethanol and fleets to be doing the same?

Dr. Berg. Senator, if I may take the question, the Department of Energy, of course, has a very strong interest in the areas that you are talking about, the whole area of alternative fuels.

But, in fact, I think perhaps you can ask the people that follow us, because I know that we have been working with Ford, General Motors and Chrysler. All of them are working on flexible fuel vehicles as, perhaps, the first term introduction of a non-petroleum based fuel.

But we are looking at a large range of alternative fuels from biomass. Biomass offers the ability to, in essence, lock a cycle, close a loop in the carbon dioxide chain in which the fuel burned then is taken up by vegetation, treated by either destructive distillation, fermentation, or other means to produce biofuel, which can be methane alcohol——

Senator Breaux. I understand the technology—I do not understand the technology, I mean, but my question is as to a broader point, not how it works, but to the point of what is going to be the driving force for the use of alternative fuels?

Is it going to be government? Is it going to be the law of supply and demand? Is it going to be a clean air bill that Congress passes that tells states they have to get their emissions standards reduced by this amount?

Is that going to generate the industry to produce vehicles that use alternative fuels? Or is it going to be the general public's request for those type vehicles? Do we have to come in here and say, all vehicles by 1995 are going to have to be susceptible to burning alternative fuels?

What I am trying to figure out, how do we get there? Is the government going to have to come in and pass laws that say you should use alternative fuels?

Dr. Berg. Senator, I think that perhaps a combination of all of the above. The reason I say that is because it is going to take the American public, the consumer, to demand to have the alternative fuel before you are going to see, number one, the vehicle manufacturers able to produce at a reasonable cost enough vehicles to meet that demand. You have a whole infrastructure that is going to have to be replaced or modified to supply those vehicles. So I think it is a combination of all of these things.

Senator Breaux. But would you agree with the fact that gasoline being, as some have pointed out, the lowest price it has been since the 1960's, when you take into consideration inflation, et cetera, and other factors, that gas is cheap? It is all imported. 40 percent to 50 percent is going to be imported fuel.

But it is cheap, at least for the present. Is there any driving force out there other than government that would encourage manufacturers and the American public, first the manufacturers to build and, number two, the American public to buy alternative fuel-driven vehicles?

Dr. **Berg**. I think again it is a combination. I think the American public and the public worldwide is beginning to understand some of the problems that are involved. There is no such thing as a free lunch. Anything we do is going to cause some sort of an opposite reaction to the atmosphere and to the environment.

And there is no panacea to any of these things that we are talking about, because regardless of what it is, it, somehow, is going to affect the way we live.

As a kid I can remember growing up when butter was 20 cents a pound and a gallon of gas was 19 cents a gallon. Well, today butter is over two dollars and gasoline hovers around a dollar. So you are right, it is a bargain at today's price.

Senator **Breaux**. Is this a recommendation by the Administration for a gas tax?

Dr. **Berg**. No recommendation at this point.

Senator **Breaux**. We have read your lips.

I think the problem that I see is that we keep switching signals from the standpoint of Congress. Our record is replete with dramatic errors. We told industry to quit burning natural gas to generate electricity. We told them to burn coal. Now we are telling them to quit burning the dirty coal and to do something else.

And we have told them to increase the CAFE standards, then we roll them back. Now we are talking about bouncing them back forward.

I mean, what kind of policy is that? To me it stinks.

Dr. **Berg**. Senator, we have got to make it such that it is a win-win-win situation: a win situation where the consumer wins, where the environment wins, where Congress and the Department of Energy and the Department of Transportation, all of us win.

We really need to rely on being able to in essence market it in such a way that the American consumer sees the need and the ability to win.

Senator **Breaux**. Well, do you not agree that the rollback—I mean anybody. Do you not think that the rollback, that was a switching of signals? That was a reaction to public pressure because we had temporarily cheap gas prices.

That is not policy. I mean, that is response to people lobbying for something. That is not a long-range policy. You would think we would be getting a recommendation that would be looking towards the next decade on CAFE standards, on alternate fuels, instead of just up and down like a yo-yo.

Dr. **Berg**. One of the policies that Secretary Watkins is really concerned with is getting the interest in our grade schools, high schools, on up in science education and mathematics. And one of the programs that we are looking at is how we can educate our children to be better consumers and users of energy efficiency.

Part of your answer is the consumer is demanding "boss cars," the heavy-duty things. You go around to the high schools, you will see them driving pickup trucks, you see them driving those fuel inefficient vehicles. And yet that is the group that we should be turning on, they should be the ones that are demanding energy efficiency.

Senator **Breaux**. Thank you.

Senator **Bryan**. Thank you very much, Senator Breaux.

And we thank each member of the panel, the Administration witnesses particularly. Let me just add that as soon as that policy review is complete so we know what your position is in increasing the CAFE standards and other recommendations that you might have, as Senator Gorton inquired about, it will be of great help to this committee in terms of processing legislation.

Thank you very much.

The next panel will consist of: Mrs. Helen O. Petrauskas, who is the Vice President, Environmental and Safety Engineering, for the Ford Motor Company; Dr. Marina V.N. Whitman, Vice President and Group Executive, Public Affairs Group, General Motors Corporation; and Mr. Robert G. Liberatore, Executive Director, Public Policy and Legislative Affairs, of Chrysler Corporation.

And may I say to the next panel without unduly cutting you off, if we can ask you to confine your testimony to five minutes. I am told that we may have votes at about 11:30 and I know that some of you have previous commitments, and we have made a promise to make sure that we get you out of here this morning and we want to honor that commitment.

Thank you very much for being here, and we will begin our testimony from this panel by hearing from Mrs. Petrauskas.

STATEMENT OF HELEN O. PETRAUSKAS, VICE PRESIDENT, ENVIRONMENTAL AND SAFETY ENGINEERING, FORD MOTOR CO.

Mrs. **Petrauskas**. Thank you very much, Mr. Chairman. I will summarize my testimony and ask that the complete statement be submitted for the record.

I would like to make several key points. First, Ford Motor Company is committed to playing an integral role in helping the nation resolve the highly complex questions involving society's environmental and energy concerns. Ford has made substantial improvements in the fuel economy of every car and truck we sell.

Such technology advances will continue in the future. In the next few years, multi-valve overhead cam engines, continuously variable and electronically controlled transmissions, and variable valve timing technologies should yield important fuel economy improvements on individual cars and trucks.

But it is difficult to forecast, as the committee has asked, how much our average fuel economy will improve as a result of these technical actions, for several reasons. First, a manufacturer's average fuel economy is strongly dependent on the mix of vehicles, engines, and transmissions consumers elect to buy. Recently, Ford technical actions have been offset by increased consumer demand for larger vehicles, engines, and power-consuming options.

Also, compliance with other Federal requirements can reduce CAFE benefits.

With regard to higher CAFE standards, we believe the policy question is not what CAFE levels are technically feasible, but whether a 35 to 45 MPG fleet can meet America's personal mobility needs. And in this regard, we think it may be worthwhile to look at what the European fleet looks like. The most recent EPA data appear to indicate that the European fleet, the new car fleet average is somewhere around 31 MPG. So if we look at what that fleet looks like, it begins to paint a picture for us what a 35 MPG fleet might be like.

And it is a very different fleet from the United States. About 80 percent of the cars in Europe are compact size or smaller. In the United States, conversely, 50 percent of the fleet is midsize or larger.

[Chart.]

As the next chart shows, more than 90 percent of European cars are equipped with manual transmissions, compared with less than 30 percent for American cars.

And then finally, in terms of use of diesel engines, they account for about 16 percent of the new car fleet in Europe, but less than a tenth of one percent in the United States.

We think it is important to recognize that in Europe there have been longstanding policies of high gasoline taxes and tax incentives to encourage the purchase of small vehicles.

But perhaps more importantly, these policies have been complemented by a substantial rail and public transit infrastructure that simply does not exist in the United States.

We support continuous improvement in car and truck fuel economy, but we would be concerned with a CAFE standard so high that personal mobility would be reduced and the affordability of vehicles threatened, as well as the competitiveness of U.S.-based manufacturers.

With respect to global warming, we believe it is important to put the potential benefits of higher CAFE standards into perspective. We estimate that even a doubling of the fuel economy of the entire U.S. car fleet would reduce the buildup of global warming gases by only one-half of one percent.

We believe the most promising contribution to global warming that the automotive sector can make is to reduce and reduce quickly the use of chlorofluorocarbons, and we have an aggressive program to identify what it will take to phase CFC's out of automotive use and how soon is that possible.

As to carbon dioxide, a greenhouse fee applied to all energy users emitting carbon dioxide could have a more far-reaching impact.

If Congress believes increases in fuel economy are necessary, we would urge the committee to consider measures that would correct two major inequities in the law. First, because CAFE is an average of all cars, small, midsized, and large, sold by manufacturers, it puts domestic full-line manufacturers at a competitive disadvantage. I will not elaborate on that because the committee has heard a lengthy discussion of that earlier.

Also as we noted earlier, CAFE is a poor measure of a manufacturer's technical effort because market changes can so easily offset the application of new technology.

We believe an equal percentage task for all manufacturers that is independent of sales mix would avoid these inequities. It should be a long term goal rather than a year over year requirement, and it should be reviewed and adjusted automatically for any changes in safety and emission requirements that reduce fuel economy.

But other approaches may be more beneficial to the whole of American policy goals. For example, there is a growing consensus that use of alternative fuels can provide benefits in the areas of clean air, in petroleum conservation, and potentially in global warming.

If indeed this approach does address the nation's concerns in all of these areas, government should then consider aggressive fleet demonstration programs for research fuel vehicles and establish incentives that stimulate consumer interest and encourage energy producers to make the fuels more widely available.

Finally, it is critical that government examine the interrelated nature of the environmental, safety, and energy goals, because approaches to one issue sometimes conflict significantly with what we are trying to accomplish on others.

What we would like to see is a national vision of where America should be 20 years from today. Then the country can decide on programs on which we must focus in the near term that are in harmony with these long term goals.

Thank you, Mr. Chairman.

[The statement follows:]

Statement of Helen O. Petrauskas
Vice President, Environmental and Safety Engineering
Ford Motor Company
Senate Committee on Commerce, Science and Transportation
May 2, 1989

We welcome the Committee's interest in our views on automotive fuel economy. Ford is committed to playing an integral role in helping the nation resolve the highly complex questions that center on society's environmental and energy concerns. I would like to comment on the outlook for further fuel economy improvement and the interrelationship of automotive fuel economy with other national issues.

Ford has made substantial improvements in the fuel economy of every car and truck we sell. The largest cars we produce today have better fuel economy than the smallest cars we produced in 1975. We achieved these improvements by incorporating advanced engine and transmission technology, improving aerodynamics, and by downsizing and other weight reduction actions.

Such technology advances will continue in the future. The most promising technologies for substantial fuel economy increases in individual models include:

- multi-valve, overhead cam engines,
- continuously variable and electronically controlled transmissions, and
- variable valve timing.

These technologies should yield important incremental fuel economy improvements, but will require some leadtime to implement and could result in higher consumer costs. For example, the new transmissions may provide fuel economies on smaller cars that could approach those normally associated with manual transmissions. There are, however, no breakthrough technologies expected to produce major increases in fuel economy. The studies often cited to support CAFE levels above 30 miles per gallon are based on concept vehicles that use diesel and two-stroke engine technologies, weigh no more than 900 to 1,900 pounds, carry two to four passengers and generally do not meet U.S. safety or emissions requirements.

It is difficult for us to forecast how much Ford CAFE will improve as a result of these technical actions because CAFE is strongly dependent on the mix of vehicles, engines and transmissions consumers elect to buy. In the past few years, Ford has seen its major technical improvements offset by increased consumer demand for larger engines, automatic transmissions, and air conditioning and other power-consuming options. For example, customer demand for automatic transmissions in Ford vehicles has increased from 80 percent in 1985 to 87 percent in the 1989 model year. Similarly, air conditioning installation has risen from 73 percent in 1985 to more than 90 percent in 1989.

Moreover, other federal requirements have reduced the CAFE benefit of these technical actions. In recent years, we have had to offset a reduction of 0.3 mpg which was caused by the addition of new safety requirements. We expect that future emission control standards and safety requirements could reduce our CAFE by about an additional 1 mpg.

But the real question is not what CAFE levels are technically feasible. Some of today's models already have fuel economy levels of 35-45 mpg. The question is whether such a fleet can meet America's personal mobility needs.

New cars sold in Europe presently achieve fuel economies in the low 30 mpgs. Personal mobility depends, however, not only on private vehicles, but on the infrastructure -- e.g., the condition and accessibility of roads -- and the availability of convenient and affordable public transportation. In Europe, there are also high gasoline taxes and tax incentives to encourage the purchase of small vehicles. These policies, however, are complemented by a substantial rail and public transit infrastructure that has been in place for many years and plays an integral role in the lives of urban dwellers and commuters in virtually every European country.

Private vehicles have better suited the longer distances in America and the rapid suburban growth of most U.S. cities. In addition, low gasoline prices have diminished the importance of purchasing the most fuel-efficient vehicles available. As a result, U.S. consumers have opted for cars that have about 20 percent more interior space as compared with the average European car (Attachment I). Also, U.S. customers are choosing engines with an average displacement in excess of 3.0 liters compared with an average European displacement of about 1.6 liters. Moreover, Europe has a much higher use of manual transmissions (Attachment II) and a substantial percentage of diesel engines (Attachment III) -- a technology that is not accepted by American consumers and has questionable environmental effects.

The consequences of higher CAFE standards are reduced personal mobility in the United States and a probable loss of competitiveness for U.S.-based manufacturers that have continued to produce a mix of vehicles, including full-size cars, that have been well suited to American consumer needs.

Moreover, higher CAFE standards will make it more difficult to achieve other national goals. There is an inherent tradeoff in controlling exhaust emissions and maximizing fuel economy. Also, it is more difficult to respond to consumer interest in improved vehicle safety with smaller, lighter vehicles.

The benefits of higher CAFE standards, on the other hand, are minimal with respect to the nation's environmental and energy concerns. The Committee asked about the impact of higher CAFE standards on global warming. Ford estimates that even a doubling of the fuel economy of the entire U.S. car fleet would reduce the buildup of global warming gases by only one-half of one percent. Since CAFE affects only new car sales, this reduction will be achieved only after 15 to 20 years.

A carbon or greenhouse fee to be applied to all fuels emitting carbon dioxide could have a more far-reaching impact by affecting all sources and uses. The most promising contribution the automotive sector can make with regard to global warming gases is the accelerated phaseout of chlorofluorocarbons (CFC). Ford has an aggressive program to identify what it will take to phase out the automotive use of CFCs as soon as possible.

If Congress believes increases in vehicle fuel economy are necessary, we would urge the Committee to examine measures that would correct two major inequities in the law. First, because CAFE is an average of all cars -- small, mid-size and large -- sold by a manufacturer, it puts domestic full-line manufacturers at a competitive disadvantage. Those manufacturers that make only small cars -- as some Asian producers do -- easily meet the standards, while those who build only top-end cars, such as Rolls Royce or Mercedes, have little hope of achieving the standards. Domestic full-line producers can meet CAFE standards only by selling enough small cars to offset their larger car sales.

If Ford or another full-line U.S. manufacturer cannot meet consumer demand for larger vehicles because of CAFE constraints, and if a foreign manufacturer is able to provide such vehicles and still meet its CAFE requirement, there is no energy savings but there is a loss of U.S. production and jobs.

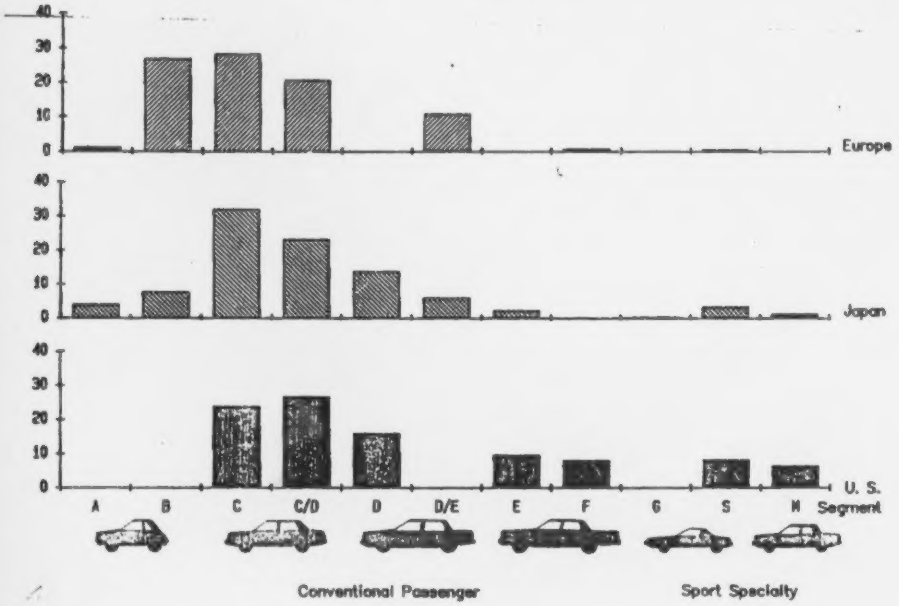
Also, as noted earlier, CAFE is a poor measure of a manufacturer's technical effort because market changes can easily offset the application of new technology.

An equal percentage task for all manufacturers that is independent of sales mix would avoid these inequities. To reduce the cost to consumers and recognize manufacturer lead-time requirements, such a task should be a long-term goal rather than a year-over-year requirement. And the goal should be adjusted automatically for any changes in safety and emissions requirements.

But other approaches may be more beneficial to the whole of American policy goals. For example, there is growing consensus that use of alternative fuels can provide benefits in the areas of clean air, petroleum conservation, and potentially, global warming. If, indeed, this single approach does address the nation's concerns in all of these areas, government should then consider aggressive fleet demonstration programs for alternative-fuel vehicles and establish incentives that stimulate consumer interest in such vehicles and encourage energy producers to expand availability of the new fuel-supply base.

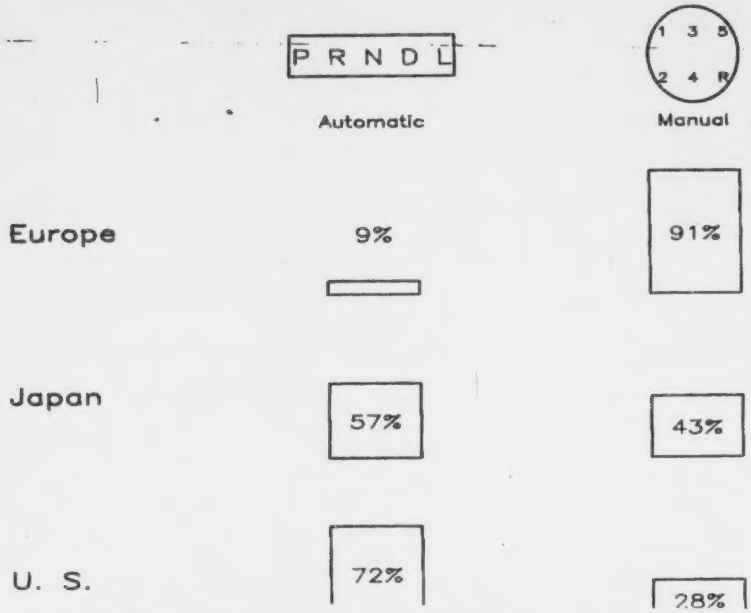
It is critical that government examine the interrelated nature of the environmental, safety and energy goals, because approaches to one issue sometimes conflict significantly with what we are trying to accomplish on others. What we need is a national vision of where America should be in these matters 20 years from today. Then the country can decide on the programs on which we must focus in the near term that are in harmony with these long-term goals. Such a vision can avoid missteps in vehicle and infrastructure programs that could cost the country and its consumers billions of dollars.

REGIONAL CAR SALES BY SEGMENT



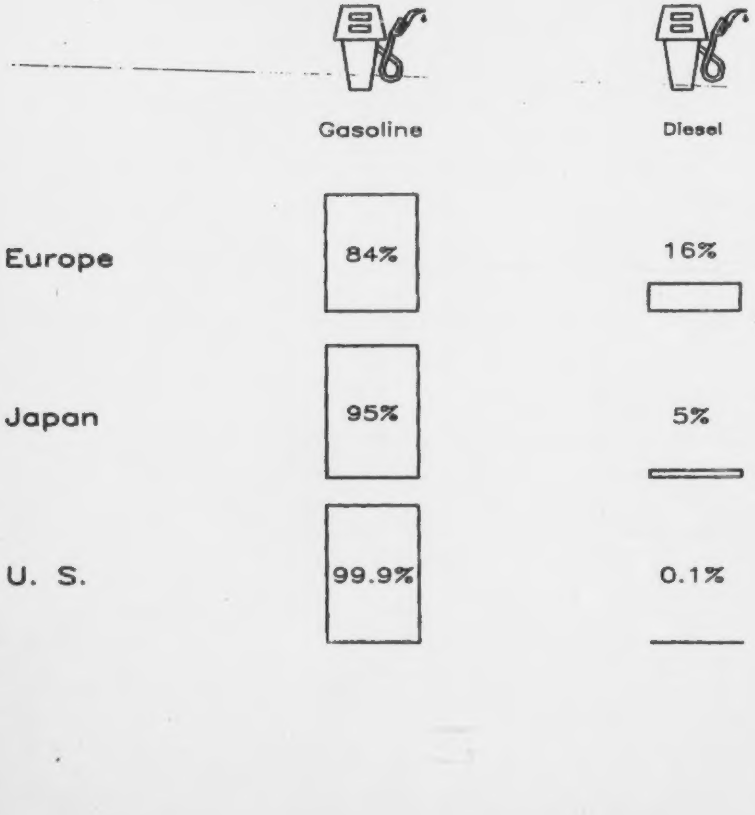
Attachment I

REGIONAL CAR SALES BY TRANSMISSION



Attachment

REGIONAL CAR SALES BY FUEL TYPE



Attachment III

Senator **Bryan**. Mrs. Petrauskas, thank you very much.

Dr. Whitman.

STATEMENT OF DR. MARINA N. WHITMAN, VICE PRESIDENT AND GROUP EXECUTIVE, PUBLIC AFFAIRS GROUP, GENERAL MOTORS CORP.

Dr. **Whitman**. Thank you, Mr. Chairman. I appreciate this opportunity to discuss the CAFE program and proposals to enact new fuel economy standards. I will also summarize our views on global warming and the reasons why higher CAFE standards are not a well-suited response.

GM's responses to the specific questions posed by the subcommittee are appended to our formal statement for the record.

We are pleased the Consumer Subcommittee has taken an active interest in CAFE because its effect is to threaten consumer choice and welfare, as well as reduce U.S.—potentially reduce U.S. automotive employment. With consumers expressing a strong preference for family-sized and better-performing vehicles, despite the recent and probably temporary run-up in gasoline prices, the CAFE law can have an anti-consumer effect by restricting consumer choice.

We believe that any regulatory program which attempts to displace market forces and change consumer priorities should meet three tests: It should be effective, it should be efficient, and it should be fair. Both the CAFE program and proposals to raise standards fail on all counts.

Concerning effectiveness, independent research and our own experience demonstrate that two factors, gasoline price and availability, not CAFE, drive consumer choice. Both factors are beyond our control.

Concerning efficiency, independent research shows that a CAFE standard that would actually increase fuel economy would do so only at a very high cost to consumers.

Concerning fairness, CAFE affects only a single energy use and, to the extent that greenhouse gas emissions are of concern, CAFE targets a remarkably small share of any forecast global warming impact.

Moreover, CAFE unfairly impacts domestic full-line manufacturers, while it creates an incentive for our Japanese competitors to produce larger and possibly less fuel efficient cars. This was a point made by a number of the government witnesses.

Since 1974, GM has increased its fuel economy by 130 percent. However, because sales of larger cars reduce the average, CAFE seriously obstructs our efforts to supply consumers what they want and distorts our focus on consumer satisfaction.

Meanwhile, Japanese and other traditionally small car producers face no CAFE restraints. In fact, several Japanese manufacturers have aggressive plans for larger luxury and midsized cars with V8 and performance V6 engines. By hindering U.S. producers from responding to this new competitive challenge, more stringent standards will reduce U.S. auto employment without affecting the mix of vehicles that is actually bought and driven.

We believe it would be a mistake to raise the CAFE standards. Research conducted by the FTC's Bureau of Economics shows Japanese firms benefiting, while full-line U.S. producers lose sales and their workers lose jobs if they attempt to alter the sales mix in order to try and force consumers into a higher CAFE fleet.

A key factor is the ability of consumers to substitute Asian for domestic cars or to retain their older, less fuel efficient cars.

For those ranges where CAFE might in fact result in some net gasoline savings overall, the FTC study warns of "an exorbitant cost to the economy."

And as the Office of Technology Assessment recently acknowledged, exotic experimental vehicles that have achieved very high fuel economy are not evidence that cost effective technology exists. The OTA has recognized that overall fleet potential is a function of consumer acceptance and, as I pointed out, this acceptance depends importantly on gasoline prices and availability.

In fact, today's GM Geo Metro, having a composite CAFE rating of 65 miles per gallon, is the most fuel efficient vehicle in the EPA buyer's guide. Yet sales of all vehicles with fuel economy greater than 50 miles per gallon were only one percent of total U.S. car sales in 1988.

Looking to the future, GM has extensive research focused on using methanol and ethanol. Indeed, tomorrow will mark the end of the Methanol Marathon here in Washington, or in Maryland, a student-engineer rally which should provide valuable real world information.

We are also focusing on improving internal combustion engine efficiency, and we are active in research and development of nonfossil fuel energy sources. Current programs include fuel cell research, electric vehicles, and the solar-powered Sunracer.

In addition, GM is actively conducting research on ways to reduce congestion, thereby reducing both fuel consumption and emissions.

But there are no technological breakthroughs affecting fuel economy on the immediate horizon.

Recently, concern about global warming has added a new dimension to the discussion of energy conservation. The policy question today is whether and what kinds of "insurance" might be reasonable.

For example, S. 169, recently reported out by the full committee, establishes a ten-year framework for research and to monitor global climate change. This bill was supported by the Motor Vehicle Manufacturers Association.

Beyond encouraging research to reduce the scientific uncertainties, GM supports the search for a practical multilateral approach mirroring the global scope of the issue. Actions by the United States alone would be marginally effective and could result in economic and competitive disadvantages.

Would it not make better sense to create incentives to reduce all emitting sources, rather than focusing attention exclusively on one particular activity, in responding to the concern about global warming? For example, a number of commentators, including EPA staff in a recent draft policy paper, have suggested a "greenhouse" or carbon fee.

Because CO_2 is a byproduct of all types of fossil fuel combustion, would not a fee structure tied to the level of carbon content of various fossil fuels be the fairer approach, as well as more effective? These are among the questions that need to be addressed promptly.

CAFE does not alter consumer demand. Currently, all that CAFE is doing is moving the customer around in the marketplace among manufacturers, at the expense of U.S. full-line manufacturers and their workers.

Higher standards would only aggravate this problem, and increases to CAFE levels draconian enough to result in a net fuel savings would at best be exorbitantly expensive and so disruptive that the impact would not be acceptable to the American public.

Thank you.

[The statement and questions and answers follow:]

STATEMENT OF DR. MARINA V.N. WHITMAN, VICE PRESIDENT AND GROUP EXECUTIVE, PUBLIC AFFAIRS STAFFS GROUP, GENERAL MOTORS CORPORATION

Mr. Chairman. I am Dr. Marina v.N. Whitman, vice-president and group executive in charge of the Public Affairs Group for General Motors Corporation. I appreciate this opportunity to discuss our views on the current CAFE program and proposed legislation to possibly raise the existing fuel economy standards. I also will discuss briefly our views on the global warming issue and indicate why we believe that an increased Corporate Average Fuel Economy (CAFE) is ill-suited as a response to it. GM's responses to the specific questions posed by the subcommittee are appended to our formal statement for the record.

We are pleased the Consumer Subcommittee has taken an active interest in this issue because, while CAFE may have been well-intended, it's effect is to threaten consumer choice, diminish consumer welfare, and endanger automotive employment. With consumers expressing a strong preference for family-size vehicles and vehicles with better performance characteristics, despite the recent, possibly quite temporary, sharp run-up in gasoline prices, the CAFE law when it binds, reduces consumer choice for Americans. For example, Congress certainly did not intend to restrict recreational activities associated with pulling trailers, campers, and boats, and intimately associated with the American way of life, but the CAFE law can have that anti-consumer effect.

Moreover, when it binds, CAFE works against the interests of American workers and carmakers by inhibiting their ability to respond to this consumer demand. Domestic full-line manufacturers are forced to be less-effective competitors at a time when we are facing our most formidable competitive challenges. For General Motors, customer satisfaction is the master plan for staying ahead in today's marketplace. We recognize that the customer is the ultimate judge of our products and that we can succeed only by satisfying customers' preferences and demands. We are listening intently to our customers and are responding with quality vehicles that offer value in today's competitive marketplace. We have developed extensive programs within the Corporation to sharpen our consumer focus. CAFE distorts this focus.

We believe that any government regulatory program which attempts to displace market forces as a means to shift priorities of the buying public should meet three tests: It should be effective, it should be efficient, and it should be fair. Both the current CAFE program and proposals to raise its standards fail all three of these basic tests.

Concerning effectiveness, independent research as well as our own experience demonstrates conclusively that actual and/or anticipated increases in gasoline prices and perceived availability, not CAFE, is what has driven consumer choice regarding the characteristics of the cars they have purchased. This implies that it has been the path of fuel prices, not CAFE, that has been overwhelmingly responsible for the improvements in motor vehicle fuel economy experienced over the last couple of decades. Concerning efficiency, independent research has shown that a CAFE standard level that would actually increase automotive fuel economy, would do so only at a very high cost to the public. Concerning fairness, CAFE affects only a single use of energy and, to the extent that emissions of so-called "greenhouse gases" are of concern, CAFE targets the source of a remarkably small share of these gases on a worldwide basis. Moreover, CAFE unfairly impacts a particular subset of vehicle producers, namely, domestic full-line manufacturers such as GM, while it creates an artificial incentive for our Japanese competitors to produce larger cars — cars that in some cases actually get poorer fuel economy than GM cars against which they directly compete.

I'll address each of these defects with CAFE more fully in the body of my statement. But first, CAFE is sometimes justified by its supporters on the grounds that it promotes energy security and/or energy conservation. Before proceeding further, it is important to be clear on these two issues.

Energy Conservation and CAFE

With respect to conservation, improvements in fuel efficiency since the early 1970s, when the first oil shock occurred, have indeed been significant. For example, the national average fuel economy of new cars has essentially doubled, from 14 mpg in 1974 to over 28 mpg in 1988. What has produced this improvement? Research by Robert Crandall and his colleagues at Brookings has demonstrated that the CAFE standards have had little, if anything, to do with this improvement. To quote from the principal conclusion of the chapter in their book, Regulating the Automobile, titled "Regulating Fuel Economy": "...the automobile producers' increase in fuel economy is about what one should have expected given the rise in gasoline prices since 1973. The CAFE standards appear to have provided little but nuisance value until recently. [However,] as gasoline prices have fallen in real terms, the standards have become a binding constraint upon producers attempting to satisfy the demand for larger cars." (p. 139)

Such research is consistent with our own experience at GM and the experience of the industry. When gasoline prices were on the rise and were forecast to keep rising, demand for fuel-efficient cars was so strong that we had no difficulty in meeting CAFE standards. In effect, the standards became redundant. But as gasoline prices have fallen, and expectations about their future path have been adjusted downward, we have been unable to induce consumers to purchase cars having high levels of fuel economy. For example, our Geo Metro, the nation's highest-rated fuel economy car with a combined EPA mileage rating of 65 mpg, constitutes only 1.5 percent of our sales today, despite our considerable marketing efforts. And the sale of automobiles with such fuel economy levels are barely 1% of total U.S. sales.

Manufacturers' recent petitions for CAFE relief are thus appropriately seen not as "backsliding" on our part, but as the inevitable result of the inconsistency between energy prices and the CAFE standards. Today, both as a result of low gasoline prices and of greatly improved automobile fuel efficiency, the fuel cost per mile is the lowest (in constant dollar terms) it has been at any point in the nation's history for which we can obtain information. Given this, it should be no surprise that we are having difficulty selling very high fuel economy as a desirable product feature relative to other product characteristics like passenger and trunk capacity.

How expensive might it turn out to be to try to use CAFE to force consumers into cars they don't really want in order to conserve energy? A rough idea is given by research conducted by Andrew Kleit of the Federal Trade Commission's Bureau of Economics. Kleit selects a particular year, assumes that CAFE is binding on manufacturers during that year, and then calculates what happens if manufacturers must alter the prices they charge for their cars to try and force consumers into a fleet having a higher CAFE. He takes account of the ability of consumers to be able to offset this by substituting Japanese cars for domestic cars. Thus his model shows Japanese firms as benefitting while American firms lose profits and their workers lose jobs. Kleit finds that for some levels of CAFE increase even the energy impact is the opposite of the intended direction, due to CAFE's well-documented tendency to cause some potential car purchasers to hold onto their older and less fuel-efficient cars for a longer time. For those ranges where CAFE might result in some net gasoline savings, it does so, in Kleit's words, "... at an exorbitant cost to the economy." (p. 25)

Energy Security & CAFE

Regarding energy security, the nation has made substantial progress since the Energy Policy and Conservation Act was passed in 1975. Our ability to deal with energy supply disruptions has greatly increased. Petroleum demand elasticity -- the ability to adjust consumption in response to price increases — has proven much greater than most experts had thought possible, both in the short run and in the long run. Likewise, supply elasticities of non-OPEC oil and oil substitutes have proven greater than most had expected. Whereas it was once thought that $100 per barrel petroleum was just around the corner, we now know that even a $40 per barrel price is probably too high to be sustainable.

We believe the best guarantee for assuring national energy security is well-functioning petroleum markets, worldwide. Since the first major oil crisis in 1973, the petroleum markets have been undergoing fundamental structural change which has created many strategic alternatives in the event of Mid-East disruption. First, strategic petroleum reserves, both here and elsewhere around the world, now provide a major cushion. Second, increased output from and reliance on more stable foreign sources such as Mexico, the North Sea, and Canada increases the diversity of supply and makes the Mid-East less critical. Finally, the decontrol of prices for petroleum and partial decontrol of natural gas in the U.S. has promoted the development of switching capacity and alternative supplies.

In addition, increased ability to switch to petroleum substitutes, particularly within industry and electric power plants, provides a major alternative. Because energy security is an important national priority, GM has supported policies, such as the Strategic Petroleum Reserve and price decontrol, that enhance such security. But, to repeat, CAFE standards are unrelated to these improvements in energy security.

CAFE Assumptions Obsolete

There were three basic assumptions behind the CAFE law, each of which is out of touch with the economic and competitive realities of 1989. The assumptions were: first, that U.S. oil prices would continue to be controlled below world market levels, which would encourage overconsumption; second, that world petroleum prices would keep on rising into the '80s and beyond, reflecting growing scarcity of petroleum-based fuels; and third, that the U.S. auto industry would be able to dictate what consumers would buy. That is, if smaller, less-powerful, more-fuel-efficient cars were what the U.S. industry was directed to build by CAFE, that's what industry could force the U.S. consumer to buy and drive, like it or not.

None of those assumptions holds true today if they ever did. U.S. oil prices have long since been decontrolled and world oil prices have declined in real terms, reflecting an increase in the number of suppliers, available production and resultant excess capacity. Finally, consumers do have a choice from among a record number of models produced by a large number of manufacturers.

With ample supplies of petroleum, increased efficiency and the decontrol of oil prices in 1981, gasoline prices have not come close to the $2.00-$2.50 per gallon which were projected for the mid 1980s by most experts just a few years ago. In fact, inflation-adjusted retail fuel prices have actually dropped to new low levels, levels below that of 1970 and about one-third of what was once predicted.

The combination of ample petroleum supplies and lower than expected gasoline prices has resulted in stronger than anticipated consumer demand for family-size cars and cars with better performance characteristics. These kinds of cars have traditionally been popular with U.S. buyers for the utility, comfort and roominess they offer. Consequently, full-line auto manufacturers such as General Motors are experiencing increasing difficulty in consistently exceeding the 27.5 mpg fuel economy standard established back in 1975.

It is important to note that our current difficulties are not the result of a failure to make product improvements. GM has maintained an on-going commitment to fuel economy improvement across the full-range of its products since before the Arab oil embargo in 1973. Since 1979 alone, GM spent over $50 billion for new products, plant and equipment to provide the capacity and the capability to build a full-range of fuel-efficient cars. We have aggressively downsized our models, made many important powertrain advances and have established aggressive technological goals, which continue to challenge our engineers. As a result, most of today's family-size cars achieve fuel economy that is better than that of many compact models in 1975. Indeed, the average fuel economy of the fleet of GM vehicles produced in 1988 has increased over 130% from model year 1974.

Unquestionably, in our quest to continue to offer the American motorist a full line of vehicles, we have not always achieved the aggressive goals we have set for our engineers. However, we have vigorously utilized the economically practicable technologies that can provide better fuel economy in our cars. The one step we have not taken is to abandon selected segments of the market. GM still attempts to provide vehicles capable of meeting the full range of transportation needs and demands.

Research and experience have both shown that fuel prices and perceived fuel availability are the most important determinants of fleet fuel efficiency. Yet, both factors are beyond the motor vehicle industry's control. As fuel prices increase or decrease, and consumer perceptions about fuel availability change, new car purchasing decisions also change.

Thus, consumers today are reacting in a rational manner to historically low gasoline prices and ample supplies of fuel in purchasing vehicles that satisfy their individual needs and wants. As we work to sharpen the focus on customer satisfaction of our entire organization, the CAFE standards are a particularly difficult obstacle. It is especially true in the case of full-line manufacturers that the CAFE standards can be a direct impediment to satisfying a full range of customer needs — needs that experience suggests will be met regardless of CAFE constraints imposed on the individual manufacturers.

Manufacturing and Product Developments

In addition to the price and availability of gasoline, other factors that influence consumer demand include general economic conditions, interest rates and the actions of competitors. All these factors are subject to great uncertainty. In 1982, for example, despite our best engineering efforts and capital investments to anticipate increased demand for high fuel efficiency, we were forced to close two assembly plants which had been fully converted to produce our new, highly fuel-efficient compact and mid-size cars. The cost of these conversions was $130 million, but the plants were closed because demand for those cars did not develop during a period of sharply declining gasoline prices. For the same reasons, an engine plant converted at a cost of about $300 million to make engines for small cars and trucks was idled in 1984 for lack of consumer demand.

Today, we have a greater capability to provide a broad array of fuel-efficient engines across a number of products than ever and we have ample capacity for smaller vehicles if consumer demand shifts. This gives us the potential to match changes in consumer demand, thereby dramatically improving our response time. Thus, we are better prepared to handle the future market conditions that may result from a variety of changes that affect the marketplace, including gasoline prices and/or availability.

Moreover, for the intermediate term, General Motors has extensive research efforts focused on improving the efficiency of the internal combustion engine, including for example, two-cycle engines and direct injection diesel engines. Over the longer term, GM is active in research and development of non-fossil fuel energy sources. Current programs include fuel cell research, electric vehicle programs and the solar-powered Sunraycer. GM is also engaged with the government in a five-year joint research effort to develop the components for an experimental automotive ceramic gas turbine engine. Finally, GM is actively engaged in research on intelligent highways to reduce congestion and thereby also reduce both petroleum consumption and tailpipe emissions. However, there are no technological breakthroughs affecting fuel economy on the immediate horizon.

With respect to pursuing alternative fuels such as ethanol and methanol, GM has an active development and demonstration program underway. Indeed, tomorrow, May 3, will be the final leg and the finish of the Methanol Marathon. The rally — which culminates five months of effort by teams of engineering students at 15 universities and colleges in the U.S. and Canada — began on April 29 at the GM Tech Center and covers 1,100 miles in five days. The Marathon should provide valuable information on how methanol performs under real-world conditions. Our largest effort to date is a demonstration program with the California Energy Commission for 2200 variable-fueled vehicles. In addition, beginning in the 1990 model year, GM's owners' manuals will recommend the use of oxygenated blends which will also have the effect of reducing gasoline consumption, as well as emissions.

The Impact of Raising the Standard

We believe it would be a serious mistake to raise the CAFE standards since it has proven to be an ineffective energy program — one that generates serious adverse impacts on consumers as well as full-line automakers and their workers.

The inequities and job-endangering characteristics of the CAFE approach are illustrated by today's situation. The CAFE standard is the same for all auto manufacturers, but it has a different impact on different manufacturers depending on the types of vehicles they build. Meeting the standard is most difficult for a manufacturer like GM that produces a full line-up of vehicles from small cars to large station wagons. Meeting the standard is easy for companies that have traditionally specialized in small cars. In Japan, for a variety of reasons, domestic demand has historically focused on smaller cars, and Japanese companies have specialized in smaller vehicles. As a result, their CAFE is in excess of the standard. One of the most perverse aspects of the CAFE law is its positive incentive to induce the Japanese manufacturers to build larger vehicles — some of which achieve poorer fuel economy than some of our larger vehicles. This is the natural result of U.S. policy that favors them at the expense of U.S. full-line manufacturers.

With fuel prices still low in inflation-adjusted terms relative to their levels of the early 1980s and a strong consumer demand for family-size cars and better-performing engines, CAFE is working against the interests of American workers and carmakers. Because sales of larger cars shifts the CAFE average downward, trying to comply with these rules seriously inhibits our ability to respond to consumer demand. As mentioned earlier, CAFE doesn't alter this demand. Meanwhile, Japanese and other small-car producers face no CAFE restraints due to their large base of small cars. And they are going after this large-car market segment aggressively, including plans to bring in cars with V-8 engines. In fact, several Japanese manufacturers have plans to bring in larger luxury and mid-size cars with V-8 and performance V-6 engines providing direct entry into the market segments in which U.S. automakers have been particularly strong. By hindering the ability of U.S. producers to respond to the new competitive challenge of the Japanese, more stringent standards will result in reduced auto employment in the United States, without necessarily affecting the mix of vehicles that is actually bought and driven.

It is important to point out that the Japanese have recently made several changes in their tax laws that will reduce significantly the higher taxes on vehicles with relatively larger engines. Again, these changes come as the Japanese are moving aggressively into the market for larger, luxury vehicles. Removal of the tax penalty for larger engines thus will help the Japanese manufacturers build a market for luxury cars in Japan and help them in their efforts to sell more upscale models in the United States.

Indeed, the average fuel economy of Japanese imports is declining. For example, a popular Japanese compact car is rated at 24 miles per gallon while GM's top-of-the-line full-size Buick Electra is at 25 miles per gallon. Thus, restricting production of Buicks and driving customers to foreign cars will not conserve fuel.

While attempts to include an "anti-backsliding" provision may present new constraints for traditional small-car manufacturers as they consider their possible compliance strategies, the full-line manufacturers will still be hurt more under this proposal. For example, the major Japanese automakers will not have to start increasing their CAFE's until the standard reaches 30-32 mpg because they are all around that level presently. Until the standards begin to challenge the Asian manufacturers, they will be able to simply substitute their new larger cars they wish to import for their mid-size models. Finally, the Japanese companies have a greater line-up of high mileage cars which they can try to use through increased sales efforts to marginally increase their CAFE, if necessary.

Technology

Some have pointed to exotic experimental vehicles as evidence that cost-effective technology exists and is not being introduced. The Office of Technology Assessment (OTA), on the other hand, does not support this view. Instead, it concludes that while certain highly optimized experimental subcompacts have attained very high fuel economy values, such vehicles do not have many of the utility and performance characteristics demanded by an overwhelming majority of consumers. OTA has recognized that overall fleet fuel economy potential is a function of consumer acceptance and, as I have pointed out, this acceptance depends importantly on gasoline prices and availability. But, again, while there are small, attractively priced subcompact models on the market today that exceed 50 mpg (EPA composite), including the GM Geo Metro which obtains a CAFE rating of 65 mpg and is the most fuel efficient vehicle in the Environmental Protection Agency (EPA) Buyer's Guide, such models represent barely 1% of U.S. sales in 1988. It is for this reason, among others that OTA has carefully distinguished its preliminary recommendation that there is a potential for the entire domestic fleet to reach 33 mpg by 1995 from a conclusion that individual manufacturers should be expected to meet a CAFE standard at that level. GM believes that even the "potential" cited by OTA for the entire domestic fleet to reach 33 mpg may be overly optimistic, because of the uncertainties regarding gasoline prices and availability (the principal determinants of consumer demand) in the future.

Safety

I have raised serious doubts regarding whether the CAFE standard does in fact affect fuel economy. But, to the extent that it does force an increase in the sales of smaller cars, there are complex safety implications that need to be understood. All other things being equal, mass is a major element of the basic principles of physics that apply in vehicle crashes. The safety research literature confirms a statistical relationship between vehicle weight and occupant fatality risk. Of course, the complexity of the other variables makes absolute correlation of CAFE and safety risks impossible. But, the issue likewise cannot be ignored. Research by Crandall and Graham has estimated the adverse impact on safety that an increase in the number of smaller cars (produced because of a binding CAFE level) might have. Assuming that the standards are binding in 1989, Crandall and Graham conclude that the larger share of model year 1989 cars that result from "mix forcing" "...will be responsible for 2,200 to 3,900 additional fatalities over the next ten years because of CAFE." (Robert Crandall and John D. Graham. "The Effect of Fuel Economy Standards on Automobile Safety," (draft, revised March 1988, p. 31.)

Global Warming

In recent months, concern about possible global warming has added a new dimension to the discussion of energy conservation. Combustion of fossil fuels, including gasoline and diesel fuel, produces carbon dioxide (CO_2), a "greenhouse gas." Currently, passenger cars account for 13% and trucks and buses account for 10% of total U.S. carbon dioxide emissions. On a global basis, this represents about 5% of all carbon dioxide emissions and about 3% of any forecast greenhouse impact, if trace gas emissions (e.g., chlorofluorocarbons and methane) are included.

Because the global warming issue has long-term implications with many scientific uncertainties, we believe strongly that realism, responsibility and reason must prevail in considering its implications for public policy. We support responses that are in proportion to our knowledge and tailored to the time horizon of the issue. The Motor Vehicle Manufacturers Association (MVMA) supported the "National Global Change Research Act of 1989" (S. 169) which establishes the framework for a 10-year plan to research and monitor global change and was recently reported out by the full committee without objection. The policy question at this point is whether and what kinds of "insurance" might be reasonable. In evaluating different policy options, I would like to reiterate, we believe effectiveness, least cost to the U.S. economy and lifestyle (efficiency), and fairness must be the decision criteria.

Beyond encouraging the research necessary to reduce the scientific uncertainties, GM supports the ongoing search for a practical multilateral approach already begun under the auspices of the United Nations. This is essential because of the global scope of the issue. Importantly, actions by the United States alone will in themselves be marginally effective in slowing the increase in global carbon dioxide emissions and could result in economic and competitive disadvantages for U.S. goods and services in world markets.

Beyond this, it is inefficient, unfair and unnecessarily disruptive to focus attention virtually exclusively on one particular activity in responding to concern about the impact of burning fossil fuels and the formation of carbon dioxide emissions on the environment. Wouldn't it make better sense to create incentives to induce all emitting sources to reduce their emissions? For example, a number of commentators, including the EPA staff in a recent draft policy paper, have suggested a "greenhouse" or carbon fee. Because CO2 is a byproduct of all types of fossil fuel combustion, wouldn't a fee structure tied to the level of carbon content of various fossil fuels be the fairer approach as well as a more effective approach? These are among the questions that need to be answered promptly.

By contrast, as described previously, increasing the CAFE standard is unfair and far more economically disruptive because it would place the efficiency burden on only one fuel and one fuel use. Such a policy would, to the extent that it had the desired effect, generate very high costs and could, in fact, detract from the search for effective and less disruptive measures.

Summary

Most economists and energy analysts agree that gasoline consumption is most influenced by changes in perceived energy availability and price. It has been the combination of these factors, rather than CAFE, that has had the dominant impact on automobile fleet fuel efficiency improvements over the last couple of decades. When petroleum prices rose, as they did from 1973 to 1981, overall fuel economy rose. When gasoline prices declined, consumer interest in fleet fuel efficiency did the same.

While one could in theory legislate CAFE increases drastic enough to reduce gasoline consumption, such gains would be very expensive to consumers as well as U.S. full-line automakers and their workers. The costs would stem from higher product prices, increased fuel consumption (caused by motorists keeping their old cars longer), and the sales lost to imports, which can be sold at lower prices since they do not face CAFE-generated costs. To quote Kleit's conclusion: "CAFE standards may or may not generate reductions in gasoline consumption. If they do, it is only at a very large cost to the economy." (p. 2)

As older, less-fuel-efficient vehicles are replaced with newer, increasingly efficient ones, the average fuel economy of the passenger car fleet will increase by a minimum of 30% by the late 1990s. Further, GM has an aggressive program for continued introduction of new, more fuel-efficient and cost-competitive cars and engines which will soon come on stream, many of which are aimed at the small car segment currently dominated by Asian imports. GM continues to pursue technologically feasible and economically practicable compliance actions. The major point to remember is that significant reductions have been made in fuel consumption. Further improvements in fuel efficiency will be incremental, whatever legislative requirements are imposed.

Currently, all that CAFE is doing is moving the customer around among manufacturers in the marketplace at the expense of U.S. full-line manufacturers and their workers. Incremental increases in the standards would only continue this problem. And, increases to CAFE levels draconian enough to result in a net fuel savings would at best be exorbitantly expensive and would be so disruptive that the impact would not be acceptable to the American public.

In closing, as Congress considers energy issues, we urge you to look at proposals from the perspective of effectiveness, efficiency and fairness. We oppose the CAFE program because it fails all three of these basic tests. It hurts the consumer and American competitiveness. In this regard, GM's President Robert C. Stempel summed up the CAFE issue best: "I want the talented people at GM to spend their time exercising the competitive spirit that we need to stay ahead in the marketplace. I want our efforts directed at finding ways to satisfy consumers and enhance their welfare. That's the way we create good jobs and make a profit for our stockholders. I don't want our people spending time trying to think how we can tinker with our products and competitive plans in nonproductive ways to reduce the value of our products to consumers just to meet a CAFE standard that creates an advantage for foreign producers without increased energy security."

Responses of General Motors Corporation to Questions from the Senate Consumer Subcommittee of the Committee on Commerce, Science, and Transportation.

Question 1: The trend in the need for imported oil to meet the nation's energy requirements, including current data on oil imports.

Response: Oil imports accounted for 37% of U.S. consumption in 1988 (vs. 27% in 1985 but down significantly from a peak of 47% in 1977). For the immediate future, the trend is that oil imports as a percentage of U.S. consumption should rise.

But this trend toward higher import share does not, in and of itself, represent a particular cause for concern for the energy security of the United States. Markets for petroleum and petroleum products are global in nature. Accordingly, the adverse consequences of hypothetical supply disruptions must be assessed with reference to the overall balance between worldwide supplies and demand of crude oil. At present and immediately foreseeable demand levels, there exists substantial world excess capacity for crude oil production, minimizing the sustainability of any large price or availability effects from a supply disruption. Furthermore, the availability of petroleum is assured in the short run by the existence of the Strategic Petroleum Reserve and similar stocks abroad.

Measures which focus primarily on energy conservation as a means of reducing energy imports may be of only marginal use in promoting energy security, because they do little to alter the balance between world supply and demand and nothing to increase the flexibility of the economy to deal with energy supply disruptions. In assessing energy security, therefore, a focus on the economy's increased ability to substitute among energy sources is far more appropriate than a narrow focus on transitory oil import levels.

It is also worth noting that an even greater percentage of many of the minerals used extensively in the U.S. are imported from foreign sources. Approximately 90% of the platinum group metals used in automotive catalytic converters are imported from South Africa. In addition, all of the graphite and manganese and three fourths of the chromium and nickel used in steelmaking are imported. All of the mica used in the electronics industry is imported. As a nation, we must be prudent in our use of imported products and materials, but we cannot expect to isolate ourselves from the rest of the world.

Question 2: The effect of gasoline use on the emission of carbon dioxide into the atmosphere.

Response: Combustion of fossil fuels, including gasoline and diesel fuel, produces carbon dioxide (CO_2), a "greenhouse gas." Currently, passenger cars account for 13% and trucks and buses account for 10% of total U.S. carbon dioxide emissions. On a global basis, this represents about 5% of all carbon dioxide emissions and about 3% of any forecast greenhouse impact, if trace gas emissions (e.g., chlorofluorocarbons and methane) are included.

Importantly, there is no linear relationship between what is emitted and what accumulates in the atmosphere. Current estimates do indicate that roughly half the emitted CO2 is absorbed by the oceans and the other half remains in the atmosphere. However, a major uncertainty omitted in some studies is the degree to which changing ocean uptakes as a result of wind stress affects CO2 absorption.

Question 3: Expected levels of your company's new vehicle passenger fleet fuel economy in the year 2000 if there is no change in federal fuel economy standards.

Response: GM has maintained an ongoing commitment to fuel economy improvement across the full-range of its products since before the Arab oil embargo in 1973. Since 1979 alone, GM spent over $50 billion for new products, plants and equipment to provide the capacity and the capability to build a full range of fuel-efficient cars. We have aggressively downsized our models, made many important powertrain advances and have established aggressive technological goals, which continue to challenge our engineers. As a result, most of today's family-size cars achieve fuel economy that is better than that of many compact models in 1975. Indeed, the average fuel economy of the fleet of GM vehicles produced in 1988 has increased over 130% from model year 1974.

Any attempt to predict a specific level by the year 2000, however, would be an exercise in speculation. Still, consistent with the preliminary findings of the Office of Technology Assessment, what can be said is that:

1) As older, less-fuel-efficient vehicles are replaced with newer, increasingly efficient ones, the average fuel economy of the passenger car fleet will increase by a minimum of 30% by the late 1990s. Further, GM has an aggressive program for continued introduction of new, more fuel-efficient and cost-competitive cars and engines, many of which are aimed at the small car segment currently dominated by Asian imports. GM continues to pursue technologically feasible and economically practicable measures.

2) Research and experience have both shown that fuel prices and perceived fuel availability are the most important determinants of fleet fuel efficiency. Yet, both factors are beyond the motor vehicle industry's control. As fuel prices increase or decrease, and consumer perceptions about fuel availability change, new car purchasing decisions also change.

3) The major point to remember is that the most significant of possible reductions in fuel consumption have already been made. Further improvements in fuel efficiency will be incremental because all of the cost effective technologies are already being exploited.

Question 4: The range of your company's achievable levels of new fleet fuel economy by the year 2000, for both passenger automobiles and light trucks, and the costs associated with achievement of each level. Include in your discussion the level that would be achieved assuming the maximum possible use of technology that is currently in production, and also assuming no performance loss or move to smaller vehicles.

Response: As mentioned in Question #3, there are a number of factors which influence consumer demand that are subject to great uncertainty and are not under our control. Today, GM offers a full line-up of vehicles from subcompacts to station wagons that range in CAFE values from 65 mpg to 23 mpg. In addition, our light trucks range in CAFE values from 33 mpg for a small truck to 15 mpg for a four-wheel drive large truck. We have a greater capability to provide a broad array of fuel-efficient engines across a number of products than ever and we have ample capacity for smaller vehicles if consumer demand shifts. This gives us the potential to match changes in consumer demand, thereby dramatically improving our response time. We are better prepared to handle the future market conditions that may result from a variety of changes that affect the marketplace, including gasoline prices and/or availability. As new cost effective technology becomes available, we would continue to include it in the fleet.

As shown in the following table, GM has incorporated every available cost-effective fuel-saving technology in its fleet to the maximum practicable degree:

GM 1989 Fleet Penetration
Representative Technology

Technology	Penetration (%)
Front Wheel Drive	88
Overdrive Transmission	57
Locking Torque Converter Clutch	100
Knock Sensor	70
Fuel Injection	98
Electronic Spark Control	93
Roller Valve Lifters	50
Low Friction Pistons	80
Low Tension Rings	79
Low Viscosity Engine Oils	94
Reduced Rolling Resistance Tires	100
Improved Aerodynamics	100

Question 5: The level of fuel economy achieved by your company, for both the domestic and foreign fleet and for passenger automobiles and light trucks, for each year from 1975 to the present

Response: General Motors Corporation
Corporate Average Fuel Economy (CAFE) — MPG

PASSENGER CARS				LIGHT TRUCKS			
Year	Domestic	Import	Std.	Year	Domestic	Import	Std
1974	12.0	—	—				
1975	15.4	—	—				
1976	16.7	—	—				
1977	17.8	—	—				
1978	19.0	**	18.0				
1979	19.1	**	19.0	1979	2WD - 17.7	—	17.2
1980	22.6	—	20.0	1980	2WD - 27.6	2WD - 27.6	16.0
					4WD - 14.9	4WD - 24.7	14.0
					Comb- 17.0		—
1981	23.8	—	22.0	1981	2WD - 18.9	2WD - 30.0	16.7
					4WD - 16.8	4WD - 26.1	15.0
					Comb- 18.6		—
1982	24.6	—	24.0	1982	2WD - 21.1	2WD - 36.1	18.0
					4WD - 19.0	4WD - 31.0	16.0
					Comb- 20.8		17.5
1983	24.0	—	26.0	1983	2WD - 20.5	—	19.5
					4WD - 20.5		17.5
					Comb- 20.5		19.0
1984	24.9	—	27.0	1984	2WD - 19.9	—	20.3
					4WD - 19.9	—	18.5
					Comb- 19.9		20.0
1985	25.8	47.9	27.5	1985	2WD - 20.0	—	19.7
					4WD - 19.9		18.9
					Comb- 20.0		19.5
1986	26.6	41.2	26.0	1986	2WD - 20.0	—	20.5
					4WD - 18.6		19.5
					Comb- 19.6		20.0
1987	26.9	39.7	26.0	1987	2WD - 20.8	—	21.0
					4WD - 19.0		19.5
					Comb- 20.2		20.5
1988	27.6	38.5	26.0	1988	2WD - 20.9	—	21.0
					4WD - 18.6		19.5
					Comb- 20.2		20.5

** For 1978 and 1979, the imported passenger cars of domestic manufacturers were permitted to be averaged in with their domestic fleets.

Question 6: The effect of increases in CAFE standards on the competitiveness of the domestic auto industry and the U.S. job market, assuming passenger car standards of 34 mpg by 2000 or 44 mpg by 2000.

Response: We believe that it would be a serious mistake to raise the CAFE standards for it would generate adverse impacts on consumers as well as full-line manufacturers and their workers.

The inequities and job-endangering characteristics of the CAFE approach are illustrated by today's situation. The CAFE standard is the same for all auto manufacturers, but it has a different impact on different manufacturers depending on the types of vehicles they build. Meeting the standard is most difficult for a manufacturer like GM that produces a full line-up of vehicles from small cars to large station wagons. Meeting the standard is easy for companies that have traditionally specialized in small cars. In Japan, for a variety of reasons, domestic demand has historically focused on smaller cars, and Japanese companies have specialized in smaller vehicles. As a result, their CAFE is in excess of the standard. One of the most perverse aspects of the CAFE law is its positive incentive to induce, at the expense of U.S. automotive employment, the Japanese manufacturers to build larger vehicles — some of which achieve poorer fuel economy than some of our larger vehicles. This is the natural result of U.S. policy that favors them at the expense of U.S. full-line manufacturers.

Some have pointed to exotic experimental vehicles as evidence that cost-effective technology exists and is not being introduced. The Office of Technology Assessment (OTA), on the other hand, does not support this view. Instead, it concludes that while certain highly optimized experimental subcompacts have attained very high fuel economy values, such vehicles do not have many of the utility and performance characteristics demanded by an overwhelming majority of consumers. In fact, there are small, attractively priced subcompact models on the market today including the GM Geo Metro — the nation's highest-rated fuel economy car which obtains a CAFE rating of 65 mpg — such models represent barely 1% of the U.S. sales in 1988. It is for this reason, among others, that OTA has carefully distinguished its preliminary recommendation that there is a potential for the entire domestic fleet to reach 33 mpg by 1995 from a conclusion that individual manufacturers should be expected to meet a CAFE standard at that level. GM believes that even the "potential" cited by OTA for the entire domestic fleet to reach 33 mpg may be overly optimistic, because of the uncertainties regarding gasoline prices and availability (the principal determinants of consumer demand) in the future. And with respect to the 44 mpg target by the year 2000, OTA recently expressed a belief that that was a virtual impossibility.

Technology aside, downsizing of vehicles particularly of the large family-size and luxury classes is an alternative but has in the past proven to be unacceptable in the market place. In 1986, GM introduced the new Riviera, Eldorado, Toronado and Seville which were downsized for the second time. Sales fell dramatically and layoffs ensued as a result of poor customer acceptance. The drastic change in the vehicles size and weight fell short of the consumer's perception, wants and needs. This necessitated an unplanned redesign of those vehicles to increase their overall length and their engine performance. By more closely matching consumer needs, with only a marginal fuel economy reduction, these newer products seem well on their way to ensuring improved job security.

To the extent that CAFE does force an increase in the sales of smaller cars, there are complex safety implications that need to be understood. All other things being equal, mass is a major element of the basic principles of physics that apply in vehicle crashes. The safety research literature confirms a statistical relationship between vehicle weight and occupant fatality risk. Of course, the complexity of the other variables makes absolute correlation of CAFE and safety risks impossible. But, the issue likewise cannot be ignored.

A final step we have not taken is to abandon selected segments of the market. GM still attempts to provide vehicles capable of meeting the full range of transportation needs and demands.

Question 7: Your view of the current structure of the CAFE standards, and any suggestions you have for improvement in that structure

Response: The current system of regulating fuel economy on a corporate average basis clearly places firms which have had a traditional presence in the market for larger cars at a competitive disadvantage to their rivals who have been traditionally absent from this sector. Producers of large cars including, most notably, American full-line manufacturers, find CAFE a binding constraint, hampering their ability to satisfy consumer demands for larger and better performing vehicles. By contrast, firms that have historically produced smaller cars, such as the Asian manufacturers and, by virtue of their larger market presence in small car segments, currently face no CAFE constraints and are free to design vehicles to satisfy consumer demand. By placing the regulatory burden of improving fuel economy on firms which have a relatively large percentage of their sales in the markets for mid- and large size cars, the current CAFE standards have clearly had the unintended impact of favoring Asian manufacturers and their employees over full-line domestic manufacturers and their employees.

We believe that any government regulatory program which attempts to displace market forces as a means to shift priorities of the buying public should meet three tests: It should be effective, it should be efficient, and it should be fair. Both the current CAFE program and proposals to raise its standard flunk all three of these basic tests. The combination of ample petroleum supplies and lower than expected gasoline prices has resulted in stronger than anticipated consumer demand for family-size cars and cars with better performance characteristics. Because sales of these cars shifts the CAFE average downward, trying to comply with these rules seriously inhibits our ability to respond to consumer demand. CAFE doesn't alter demand. it only impacts vehicle supply. Consequently, all that CAFE is doing is moving the customer around among manufacturers in the marketplace at the expense of U.S. full-line manufacturers and their workers. Incremental increases in the standards would only continue this problem. And, increases to levels draconian enough that CAFE could conceivably result in a net fuel savings would at best be exorbitantly expensive and would be so disruptive that the impact would not be acceptable to the American public.

We believe that policies which work with market forces to the greatest extent possible are more effective than attempts to force behavior by mandated measures since market-oriented policies which allow for decentralized decision-making will ultimately find the most cost effective conservation measures. If policy-making is to be rational and cost effective, it should be guided by clear awareness of costs and tradeoffs. Even the recent draft EPA Report which purported realistic policy options for stabilizing global climate acknowledged that costs were largely ignored. We believe the marketplace will reveal the nature of those tradeoffs.

Question 8: Summaries of any consumer or marketing surveys or analyses performed by or for your company to ascertain consumer preference with respect to vehicle size, or to determine the effectiveness of emphasizing environmental issues or fuel efficiency in sales efforts.

Response: Independent marketing surveys show an increased consumer preference for cars which offer greater passenger capacity. In addition, as GM sales demonstrate consumers are increasingly opting for increased comfort and entry/exit ease by choosing cars which are more fully equipped with options such as air conditioning, and 4-door sedans over 2-door coupes. Each of these consumer trends has a negative effect upon fuel economy because they result in consumers choosing larger, heavier cars. Moreover, to maintain the same performance in cars which are heavier, or are anticipated to be used to carry more passengers, increased performance is required from the powertrain. This cannot be achieved without some degradation in fuel economy.

On the issue of fuel efficiency, marketing survey results indicate that fuel economy is of lesser importance to new car buyers. In a 1988 J.D. Powers survey of new car buyers, when they were asked what is the single most important feature when selecting a new car, only 3% answered "fuel economy". This response rate had dropped from 33% in 1980.

Question 9: The amount, stated in dollars and in percentage of sales receipts, that your company has spent on research and development of fuel efficiency technology in each year since 1975.

Response: GM's investments in products having increasingly better fuel efficiency began even before 1975 and led to the development of the Chevette 3 years before CAFE standards first took effect. Over the years, the pace of change and spending to achieve it, has been constant. GM does not maintain records in the format requested. What can be said with confidence is that $50 billion has been sent since '79; or an average rate of $5 billion/year just in the past decade alone.

Senator **Bryan**. Thank you very much, Dr. Whitman.

Is it Mr. "LEE-bra-tor"? Do I pronounce that correctly, sir?

Mr. **Liberatore**. Yes. Lib-er-a-tore.

Senator **Bryan**. We will go next to you.

STATEMENT OF ROBERT G. LIBERATORE, EXECUTIVE DIRECTOR, PUBLIC POLICY AND LEGISLATIVE AFFAIRS, CHRYSLER CORP.

Mr. **Liberatore**. Let me start by saying that Chrysler supports energy conservation as a national policy, and expects to play a role in any meaningful national effort. We believe that we bring a unique perspective to the issue of CAFE. We have consistently met or exceeded the mileage standards created by EPCA in 1975.

We opposed the CAFE rollbacks that were implemented for model year 1986 through model year 1989. As you know, these rollbacks were supported by the Reagan Administration, in the courts, and tacitly by Congress.

You may recall a vote in the Senate in 1985 urging the Secretary not to roll back the standards. That vote survived a tabling motion by two votes and was summarily dropped in conference.

I offer this history not to reopen a debate about what is past, but to put Chrysler's present position in some perspective.

The recent history of the CAFE program makes us extremely leery about new additional fits and starts in government energy policy. Let me tell you about what we see going on in the marketplace today.

Over the past several years, we have seen an erosion of consumer interest in fuel economy. In 1960 gas mileage was the second most important factor affecting a new car buyer's decision on which car to buy. Today it is ninth.

Why have consumers lost interest in fuel efficiency? The answer is simple: It is the cost of fuel. If for inflation and for the doubling of the fuel efficiency of the new fleet gasoline, costs the consumer half of what it cost in 1960 to drive one mile.

We are a long lead industry. We have to take our signals from the consumer and from government as we develop our future product plans. We now have plans in place for 1993 and 1994 based on the signals we got from government in the last several years, and the signals we are getting from the consumer.

If government is now going to change signals and suddenly reawaken to the importance of CAFE, it must do so in a way which gives us adequate lead time to shift our plan from the last policy shift of the government.

That does not mean there are no opportunities for fuel efficiency improvement. There are.

I would like to urge you to keep a few points in mind, though. One, large leaps, significant leaps, breakthrough leaps, are either going to require new technologies that are not on the shelf, or they are going to require significant downsizing of the fleet. There is simply no alternative.

Some improvement can be made, as was suggested today in OTA's testimony, by diffusing existing technology. We are not comfortable with the CAFE levels OTA believes to be achievable by 1995 by diffusing technology. We would argue that this diffusion of existing technology will not be free and will take years to accomplish.

Number three, fuel prices will have much more impact on energy conservation than will a regulatory device like CAFE.

And four, any change in the CAFE requirement must take into account the impact on the domestic industry versus foreign competition, and on the millions of jobs and hundreds of communities that depend on the U.S. auto industry.

Let me elaborate on the issue of market forces and energy prices. CAFE regulation can only counter market forces at the margin. There are 180 million vehicles on the road today. If you are going to go mining for energy conservation, the mother lode is in the vehicles that are already on the road today. Changing CAFE does not alter the consumption patterns of the users of those vehicles already on the road.

It may be much easier politically to legislate increases in CAFE than it would be to raise energy fuel taxes. It may be easier, but it is less economically efficient.

The single largest component in our trade imbalance is the automotive sector. We import $58 billion worth of cars, trucks, and parts in excess of what we export. That compares to the next largest segment in the trade imbalance, petroleum, at approximately $40 billion. So we are 50 percent again as big as the petroleum imbalance.

If you increase CAFE the wrong way, that is, not asking a proportional increase among all the manufacturers, you are going to make that trade imbalance worse, not better. Why is that? Currently 85 percent of the cars sold in the United States by foreign manufacturers are in the compact and smaller segments. That should come as no surprise. That is what they make in their own markets.

And why do they make those kind of cars in their own markets? Because fuel is priced at three or four dollars a gallon in those markets. So small cars are their natural strength.

They are currently mounting a major offensive against the domestic manufacturers' natural base, in the mid, large, and luxury segments. We urge you not to change CAFE in a way that will help them in this assault.

Finally, I should say a word about the prospect for major technological breakthroughs. We believe that perhaps the biggest opportunity for these breakthroughs may lie in cooperation among the industry, government, and the universities to pool our resources and seriously look for major, dramatic leaps, as Senator Gore was addressing earlier in his questions.

In summary then, Chrysler Corporation has led the way in fuel conservation and in support of CAFE. We believe that certain modest levels of improvement can be achieved in CAFE, given adequate lead time and with an appreciation of the very significant costs involved in diffusing existing technology.

Existing technology can be diffused more quickly and major breakthroughs will be much more likely at higher fuel prices. We recommend energy taxes or fees as the most effective way to spur energy conservation.

We caution that changes in the CAFE standards must take into account their impact on the competitiveness of the domestic industry. And finally, we offer our cooperation and our technical and policy resources to this committee as you move forward on this issue.

Thank you.

[The statement and questions and answers follow:]

CHRYSLER
CORPORATION

Statement by Robert G. Liberatore, Executive Director - Public Policy and Legislative Affairs, Chrysler Corporation, at a Hearing on Global Warming and Corporate Average Fuel Economy (CAFE) Standards, before the Senate Committee on Commerce, Science and Transportation's Consumer Subcommittee, Washington, D.C., May 2, 1989.

Thank you and good morning. I am Robert Liberatore, Executive Director of Public Policy and Legislative Affairs for Chrysler Corporation.

Chrysler Corporation is pleased to have the opportunity to appear before the Senate Commerce Committee as you consider the subject of Corporate Average Fuel Economy (CAFE). Few public policy issues have such a direct impact on the products we produce, and on the potential health of our industry.

Let me start by saying that we believe energy conservation should be a national priority, and we expect to make our fair contribution to any meaningful national effort. We readily offer our technical and policy expertise to this Committee.

While global warming and CAFE are related subjects, we believe that the potential impact of CAFE on the global issue of planetary warming are difficult to demonstrate. For that reason, our testimony today deals with several broad policy issues of the CAFE program. Please see Appendix 1, Global Warming Facts, for some data which may help to put the issue in perspective.

Chrysler brings a unique perspective to the CAFE issue. We have consistently met or exceeded the mileage standard for cars set by the Energy Policy and Conservation Act of 1975. Please see Exhibit 1. We're the company that popularized front-wheel drive in America. We're the company that invented a whole new market with our minivan -- a revolutionary packaging of the family vehicle in terms of space and fuel efficiency.

Chrysler opposed the CAFE rollbacks that were implemented for model years 1986, 1987, 1988 and 1989. We did so despite enormous pressure from our competitors to go along with the lower levels they were seeking. The rollbacks were supported by the Administration, in the courts, and in Congress. Many of you will remember a Senate vote on this subject in the fall of 1985 in which a Sense of the Senate Resolution offered by Senators Evans and Lautenberg survived a tabling motion by two votes. It urged the Secretary not to lower the standards below 27.5 mpg. The Resolution was dropped in conference.

I offer this history not to reopen a debate about what has passed, but to put Chrysler's present position in perspective. Of the domestic companies, we are the only one today that continues to meet the standard originally enacted by the Congress. Yet the recent history of the CAFE program makes us extremely leery of additional fits and starts in government energy policy.

Over the past several years we have seen an erosion of consumer interest in fuel efficiency as a motive for car buying. In fact, in 1980 gas mileage was the second most important factor affecting a new car purchase. Today it is ninth. Consumers have become much more interested in comfort, performance and safety.

Throughout this period Chrysler vigorously and consistently advocated a meaningful gasoline tax to keep consumers attuned to the importance of fuel efficiency. As we know, despite the obvious need for federal revenue to reduce the budget deficit, despite the growing dependence on foreign oil, and despite the efforts of several members of this Committee and other members of Congress, meaningful energy taxes have not been adopted.

The primary reason for the lack of keen interest in fuel efficiency is the cost of gasoline. The cost of gasoline, per mile driven, after adjusting for inflation and the tremendous gains in fuel efficiency of the fleet, is cheaper today than at any time in our history. On this basis, the cost of gasoline is about one-half what it was in 1960. Other than CAFE, we have had no government policies to offset cheap gasoline. And CAFE policy has been quite fickle. For some time we have had signals from government that conservation was passe', and that the marketplace ruled.

So, over the last several years, Chrysler has had to adjust its future vehicle plan to be more in line with the changing demands of the marketplace. In 1987 Chrysler Corporation had no six-cylinder engines in its passenger car fleet. In model year 1990 we plan to sell more than one million units of passenger cars or minivans with six-cylinder engines.

We have already locked into product plan decisions for the 1993 and 1994 model years, based on the latest round of signals we got from the government. These products will live through the decade. If government is now going to change signals, it must do so in a way that gives us adequate lead time to adjust from the last policy shift. And it must design a policy that is credible. That means it must not be in such conflict with market forces that it puts us at war with our own customers and virtually requires another upheaval a few years from now, when it becomes clear that some auto makers are not going to meet the new standards.

This doesn't mean that there are no opportunities for increased vehicle fuel efficiency. There are. Working together we can identify the most fruitful opportunities. But, as you consider where we go from here, we would urge you to keep several points in mind:

1. Large leaps in new fleet fuel economy will require one of two things: either major technological breakthroughs (which at least for the moment do not appear at hand), or significant downsizing of the fleet. There is simply no easy alternative.

2. The industry can achieve some additional gains, without dramatic downsizing, by taking the best of the existing technology and building it into a higher proportion of the existing fleet. But we are talking about modest improvements that will take years to achieve. And they will not be free. On the contrary, they are sure to require a significant increase in the cost of new vehicles, especially if they are the result of government regulation which imposes uneconomic deadlines for their introduction. For example, if the industry increased the application of smaller, multi-valved engines, we could achieve some fuel economy improvement. But, depending on timing, that approach could add significantly to the cost of each vehicle that now lacks such an engine. One multi-valve engine is in the market today as an option with a manufacturer's suggested retail price of $660.

3. Fuel prices, and consumer expectations about their future level, will ultimately have much more impact on the fuel efficiency of our fleet and on total fuel consumption than regulatory devices like CAFE. Taxes or fees imposed either at the pump, or on imported oil, or on all carbon-based fuels, would encourage immediate conservation from all vehicles in the existing fleet of 180 million vehicles, speed up the diffusion of existing technology through the new fleet, and encourage and reward the investment of resources in the search for breakthrough technology.

4. Any changes in CAFE requirements must take into account their potential impact on the domestic industry -- and the jobs and communities that depend on it. Over the past dozen years we've seen U.S. auto producers shoulder a disproportionate share of the burden of increasing overall automotive fuel economy. We must not make that mistake again. Raising CAFE standards too high -- and especially without sufficient lead time -- could force American producers

to concede large portions of the middle and large-car segments to our foreign rivals, who are already mounting a major challenge in these areas.

These last two points deserve some elaboration.

Any successful, long-term solution to the energy conservation problem must focus as much as possible on market incentives instead of just focusing on regulatory schemes. Chrysler believes that CAFE can and should serve as a regulatory safety net, ensuring that zigzags in market conditions do not lead producers to let new car CAFE erode. CAFE regulation can counter market forces at the margin. That is, by encouraging mix management, diffusion of technology, and generally focusing the industry on fuel efficiency, CAFE can cause the new car fleet to be somewhat higher than it might have been in its absence.

But CAFE cannot be a total substitute for market forces. Chrysler was able to meet the CAFE standard of 27.5 mpg, which was enacted in 1975, not because the standard was written into law, but because another law, the law of supply and demand, created a demand for fuel-efficient vehicles.

The oil shock of 1979, with its attendant gas lines and soaring fuel prices, made possible the achievement of significantly higher CAFE. Shortages and expensive gas in the early '80s created a market receptive to lighter, smaller and more efficient vehicles. See Exhibit 2. It also helped change driving patterns and fuel use for a period of time. In such a market, Chrysler could build and sell at a profit new, efficient vehicles in which we had invested significant amounts of money, with little risk of their rejection by the market.

As consumer interest in fuel economy has declined over the second half of this decade, auto makers have faced greater pressures on their CAFE levels. If we are now compelled to produce smaller and more efficient vehicles that our customers do not want, we will have to price them to clear a reluctant market.

Those price levels may not be sufficient to permit manufacturers to recoup their investment in building these new vehicles. We should not be expected to force feed the market.

The short of it is that with customer demand now shaped largely by our gasoline prices, which are far below world retail levels, we cannot raise fuel economy levels dramatically by the stroke of a regulator's pen. Cheap fuel and high CAFE can cripple the industry.

Moreover, by pricing energy resources more realistically, we can make energy conservation gains that exceed those available from CAFE increases. There are approximately 180 million vehicles on the road today. Changing CAFE standards does not encourage the drivers of those vehicles to conserve. Changing CAFE standards does not cause consumers to keep their cars properly maintained. Changing CAFE standards does not encourage the retirement of old clunkers that do not belong on the road if we are serious about conservation, environmental pollution, and safety. Thirty percent of the cars on the road today are ten years or older. An acceleration of the scrappage rate would significantly increase in-use fuel efficiency. If we are going mining for oil conservation to help with global warming, the motherlode is to be found in the fleet that's already on the road, not from marginal increases in the new car fleet. We understand that it's politically easier to legislate new regulations affecting the auto industry than to effect energy costs directly to encourage conservation. It may be easier, but it is much less economically efficient.

This brings me to the second point I want to stress -- the need for an equitable sharing of the burden between domestic and foreign manufacturers.

In this competitive world, any change in government policy must be analyzed for its impact on domestic production and employment. How would CAFE changes affect trade? CAFE regulations, by reducing oil consumption, could improve the petroleum account in the balance of trade. And the balance of trade surely needs fixing.

But we caution that precipitous and poorly informed actions in the CAFE area could cause the trade imbalance to worsen, not improve. The single largest component in our trade imbalance with the world, and especially Japan, is the automotive sector. In 1988 we imported $58 billion more in cars, trucks and parts than we exported. In contrast, our petroleum and derivitive imbalance was $37 billion.

Imports now control almost thirty percent of the new car sales market; almost 40 percent if the U.S. transplants are included. Excluding trade within Europe, no other auto-producing nation has ceded this percentage of its market to foreign makers.

Currently, more than 85 percent of the foreign makers' U.S. sales are in the subcompact, small specialty, and compact segments. A comparison of the domestic and import segmentation is contained in Exhibit 3. They control 60 percent of these markets in the U.S. Their predominance in these segments is quite simple to explain. In their home markets they face energy prices that contain an enormous dose of taxes. For example, in 1988 gasoline cost $3.40 per gallon in Japan, and $3.06 in France. Please see Exhibit 4. The high price of gasoline has nurtured an industry in which consumers reward fuel efficiency. And it's not just a question of gasoline prices. Numerous taxes and regulations in Japan and Europe are designed to penalize the purchaser of larger cars, and encourage the disposal of less efficient cars.

Not surprisingly, therefore, 95 percent of new cars registered in Japan are in the subcompact and compact area; over 80 percent in Europe. For the Europeans and the Japanese, this is their natural base, and they enjoy huge economies of scale in this base. By the way, they have achieved this predominantly small car mix without CAFE laws.

Conversely, in the United States, where fuel prices are dirt cheap by world standards, the industry's predominant segments are from compact up, compared with Japan and Europe, which are compact-segment down. It is not surprising that some of the leading technological developments in fuel efficiency have come in those markets where the consumer, because of energy tax and other government policies, is willing to pay for them.

This is not to say that higher fleet averages in other countries are due to generally superior technology. They are not. Their fleet averages are higher because their fleets consist almost exclusively of small cars. In fact, as can be seen in Exhibit 5, on a head-to-head basis domestic cars have better fuel efficiency in the luxury and basic middle segments, and the imports have better efficiency in the subcompact segment. Not surprisingly, we each do better in our areas of natural strength.

This is the environment in which we have to think about possible future changes in CAFE requirements. We can no longer afford the wishful thinking that our domestic industry is strong enough to carry the entire burden.

The CAFE scheme was designed to increase the efficiency of the entire new car fleet by requiring each manufacturer to achieve the same minimum average. That approach assumed that all manufacturers were similarly situated, so all would have to share in the burden of improving overall fuel economy.

But the premise was wrong. Foreign manufacturers that concentrated on small cars didn't have to do anything to meet CAFE requirements, since their fleet mix did the job for them. By contrast, the full-line domestic manufacturers were forced to make enormous investments in new technology to improve the efficiency of their large cars, and they were simultaneously compelled to move down into the already crowded compact and subcompact segments to overcome the effects of their fleet mix.

It's as if we tried to get a 20 percent fuel economy improvement across the board, not by asking every manufacturer to improve by that amount, but instead by telling half the companies to raise their levels by 40 percent.

The small car manufacturers are mounting a major offensive against our own base -- the mid-size and large-car segments. Three major Japanese auto companies have developed upscale divisions, providing bigger, heavier, more powerful vehicles than had been their typical offering. Because their base fleet is in the subcompact area, and because of the vast supply of credits they have accumulated, they can offer these vehicles with little regard to their CAFE impact.

If the domestic manufacturers are incapacitated by new CAFE requirements, we will simply not be able to respond effectively to their challenge.

Thus, if any changes are to be made to the CAFE law, it is imperative that they assure an equitable sharing of the overall burden and not competitively disadvantage the domestic industry. In the late '70s and early '80s we were given an all too real lesson on the significance of the domestic industry to the U.S. economy. Representing almost four percent of our entire economy, automotive manufacturing has to be considered among our most critical industries.

Finally, I should say a word about the prospect for technological breakthroughs, and what the government can do to help. Over the longer term, it is certainly possible that we will have breakthroughs that take us well beyond the fuel efficiency levels achievable with existing technologies. As I said earlier, consumer demand for these breakthroughs will bring them about much more quickly than will government regulation. And consumer demand is not likely to change without a change in fuel prices.

The opportunity for technological breakthrough may be found in joint industry/government cooperation. If we are trying to address a national and in fact global concern, surely the time has come for a Sematech for the auto industry. Perhaps another mechanism would be more appropriate. But the goal would be to bring together the best minds in private industry, the universities and the government, and pool our resources to achieve major breakthroughs in drive-train technology. The list of potential areas of investigation is long, but could include an electric vehicle, clean burning engines, etc. The government played a crucial role in establishing this kind of mechanism in the computer chip area. The automobile industry is no less important to our nation's economic security.

In summary, Chrysler Corporation has led the way in fuel conservation and in support of CAFE. We believe that certain modest levels of improvement can be achieved in CAFE with adequate lead time and with an appreciation of the very large costs involved in "diffusing" existing technology. Existing technology can be diffused more quickly, and major technological breakthroughs will be more likely, at higher fuel prices. We recommend energy taxes or fees as the most effective way to spur energy conservation. We caution that changes in CAFE standards must take into account their impact on the competitiveness of the domestic industry specifically, and the trade balance more generally. And we urge a cooperative atmosphere between the industry and government in trying to identify the most sensible and meaningful steps to take to achieve energy conservation.

Finally, we offer to cooperate with this Committee to the fullest extent possible as it considers this issue. We believe that we can serve as a useful and credible resource to the Committee. It is in our interest and in the national interest that you make the most informed decisions possible. Thank you.

APPENDIX 1

THE ROLE OF THE AUTOMOBILE INDUSTRY IN GLOBAL WARMING

Vehicle Emissions of Carbon Dioxide

- A motor vehicle that is operating properly with a modern emission control system will burn essentially 100% of its gasoline into water (H_2O) and carbon dioxide (CO_2), two normally harmless chemicals.

- Carbon dioxide presently accounts for half the potential global warming effect, but other trace gases (methane, nitrous oxide, chlorofluorocarbons, ozone, etc.) are increasingly important.

- U.S. highway cars and light trucks contribute 20% of the U.S. CO_2 emissions from fossil fuels, or about 10% of the total U.S. greenhouse gases from all sources (since CO_2 is only half of all greenhouse gas emissions). The U.S. share of the world's greenhouse gases is 21%. If U.S. cars and trucks are responsible for about 10% of the U.S. greenhouse emissions, then they are responsible for only 2.1% of the world's total (i.e. 10% of 21% equals 2.1%).

- The U.S. share of the world's greenhouse gas emissions is declining as developing countries improve their standards of living with higher energy consumption. Even a small increase in fossil fuel combustion in India or China would overwhelm any reductions made in the U.S. The extent of the world problem clearly indicates the futility of narrow, unilateral actions by any country. Only serious international negotiation is capable of addressing what is truly a global problem.

- Over the last 10 years, Chrysler Motors has doubled the average fuel efficiency of the vehicles it sells. Each vehicle burns only half as much gasoline as before, and thus emits only half as much CO_2.

- While Chrysler expects to make a fair contribution to any meaningful effort to prevent global warming, the 50% reduction in CO_2 emissions already achieved must be recognized as a significant technological accomplishment. Future additional reductions will clearly become increasingly difficult.

Vehicle Air Conditioners and Global Warming

- All vehicle air conditioners presently manufactured use chlorofluorocarbon-12 (CFC-12) as a refrigerant (about 40 oz. per vehicle is typical).

- The use of CFC-12 and other CFCs is being phased down by international treaty because of their chemical depletion effects on the earth's stratospheric ozone layer.

- CFC-12 and the other CFCs are also under scrutiny due to their physical properties (i.e. infrared absorption) that contribute to perhaps 14% of global warming. Note that CFCs may have 10,000 times as much warming potential as CO_2 on a per molecule basis.

- Chrysler Motors has taken a very proactive stand on CFC rulemaking and actively cooperated with EPA to negotiate sound Corporate and public policy.
- In a November 1, 1988 letter to EPA Administrator Lee Thomas, Chrysler agreed that the weight of scientific evidence now makes a complete phase-out of CFCs both necessary and inevitable. Consequently, Chrysler has accelerated its efforts to find a suitable replacement for the CFC-12 refrigerant used in Chrysler vehicles.
- It cannot be emphasized too strongly, however, that serious technological and leadtime problems remain to be solved, and that no exact phase-out schedule can be guaranteed.
- To help significantly extend existing supplies of CFC-12 while substitutes are being developed during this transition period, Chrysler has joined in a voluntary program with other auto companies, the Mobile Air Conditioning Society, and EPA to develop standards for recovering/recycling of used refrigerant during servicing. That program will start this year, taking about 2-3 years to place recycling equipment in all service outlets.
- Barring unforeseen technology problems, Chrysler hopes to have all its vehicle assembly plants converted to a new refrigerant well before 1998, thus making a significant contribution to prevention of global warming as well as prevention of ozone depletion.

References

"The Changing Atmosphere," Chemical & Engineering News Special Issue, November 24, 1986.

Chrysler letter to EPA Administrator Lee Thomas, dated November 1, 1988, on Protection of Stratospheric Ozone; EPA Docket No. A-88-27.

"Global Climatic Change," Scientific American, 260, 36, April 1989.

"Global Warming," Chemical & Engineering News, pp. 25-44, March 13, 1989.

"Policy Options for Stabilizing Global Climate (Fact Sheet)," EPA draft report to Congress, March 1989.

Certification & Regulatory Programs
NAN 04/28/89

DOC15-Role

EXHIBIT 1

Passenger Car CAFE Comparison

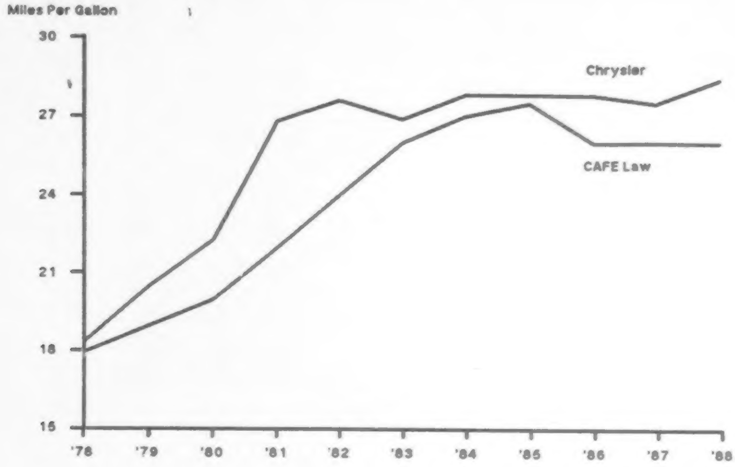


EXHIBIT 2

Industry Segment Trends

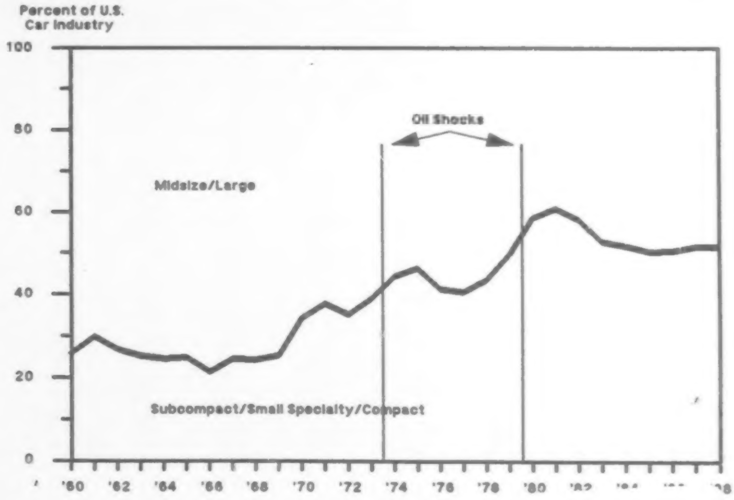


EXHIBIT 3

Car Segment Mix By Source - 1988

Percent of Total

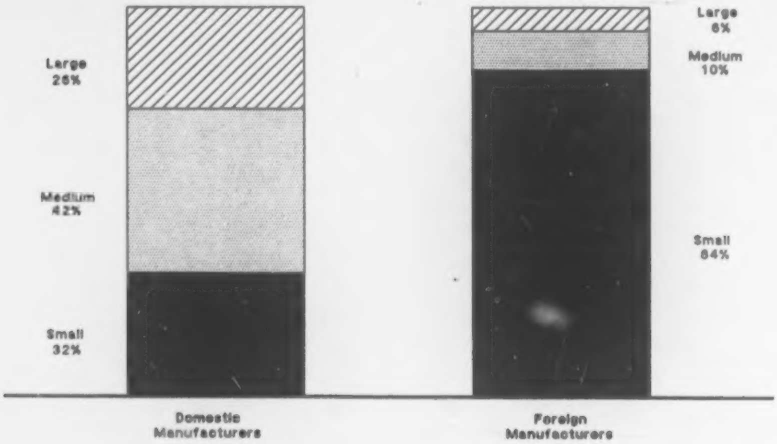
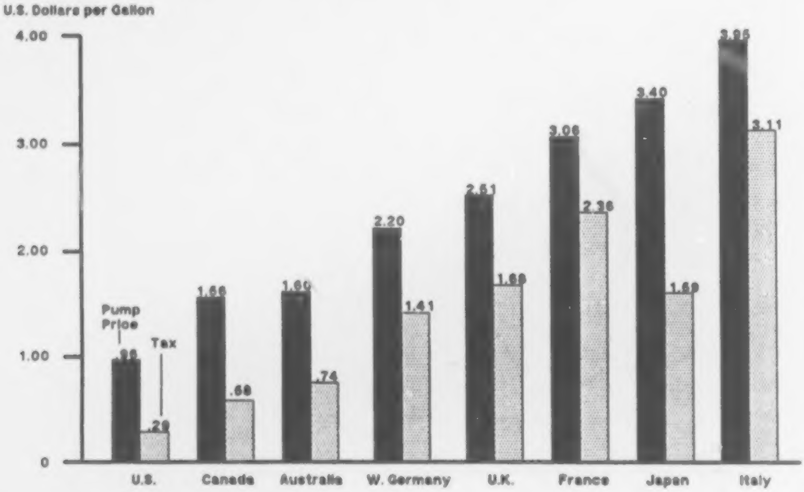


EXHIBIT 4

Gasoline Prices and Taxes, 1988

Selected Countries

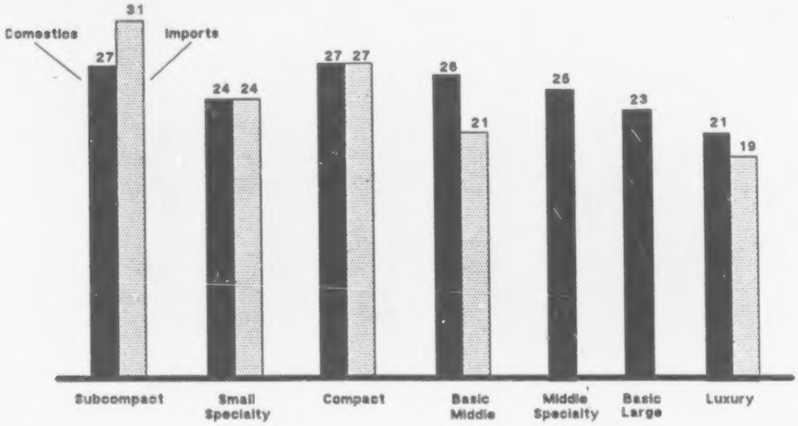


Source: International Energy Agency, OECD

EXHIBIT 5

EPA Mileage Comparisons By Car Segment - 1988

Average of City & Highway Mileage



QUESTIONS OF SENATOR BRYAN AND THE ANSWERS

Question 1

At the hearing your witnesses were shown a chart containing data from the World Resources Institute about the relative contribution of U.S. gasoline use to worldwide carbon dioxide emissions. That data indicated that U.S. carbon dioxide emissions from gasoline alone were higher than carbon dioxide emissions from all sources in each of the following areas of the world: Japan, the Middle East, West Germany, United Kingdom, Latin America, South and South East Asia, Africa and France. Do you agree that this data is accurate? If not, please state specifically in what way it is inaccurate, and state what you believe to be accurate data on this point.

Chrysler's Response

Chrysler has no independent means of judging the accuracy of the data presented in the chart (Attachment B). The data suggests that the U.S. motor vehicle fleet played a singular role in the world's global warming problem. Note the following points:

- The U.S. is a large country with a very high standard of living. Any economic statistical comparison between the U.S. and a small developed country, or a large undeveloped region, could reasonably be expected to appear the same as this CO_2 chart. The approach used is designed to exaggerate the U.S. role, relative to the total world problem.

- U.S. highway cars and light trucks contribute 20% of the U.S. CO_2 emissions from fossil fuels, or about 10% of the total U.S. greenhouse gases from all sources (since CO_2 is only half of all greenhouse gas emissions). The U.S. share of the world's greenhouse gases is 21%. If CO_2 from U.S. cars and trucks is responsible for about 10% of the U.S. greenhouse emissions, then U.S. Vehicle CO_2 is responsible for only 2.1% of the world's total global warming (i.e., 10% of 21% equals 2.1%). This result in proper context is completely different than the erroneous impression generated by the WRI bar chart.

- The U.S. share of the world's greenhouse gas emissions is declining as developing countries improve their standards of living with higher energy consumption. Evan a small increase in fossil fuel combustion in India or China would overwhelm any reductions made in the U.S. The extent of the world problem clearly indicates the futility of narrow, unilateral actions by any country. Only serious international negotiation is capable of addressing what is truly a global problem.

- Over the last 10 years, Chrysler Motors has doubled the average fuel efficiency of the vehicles it sells. Each vehicle burns only half as much gasoline as before, and thus emits only half as much CO_2. In addition, we have publicly committed ourselves to finding environmentally safe substitutes for chlorofluorocarbons (CFCs) used in our vehicles. This CFC reduction will make an equally significant improvement in the global warming situation.

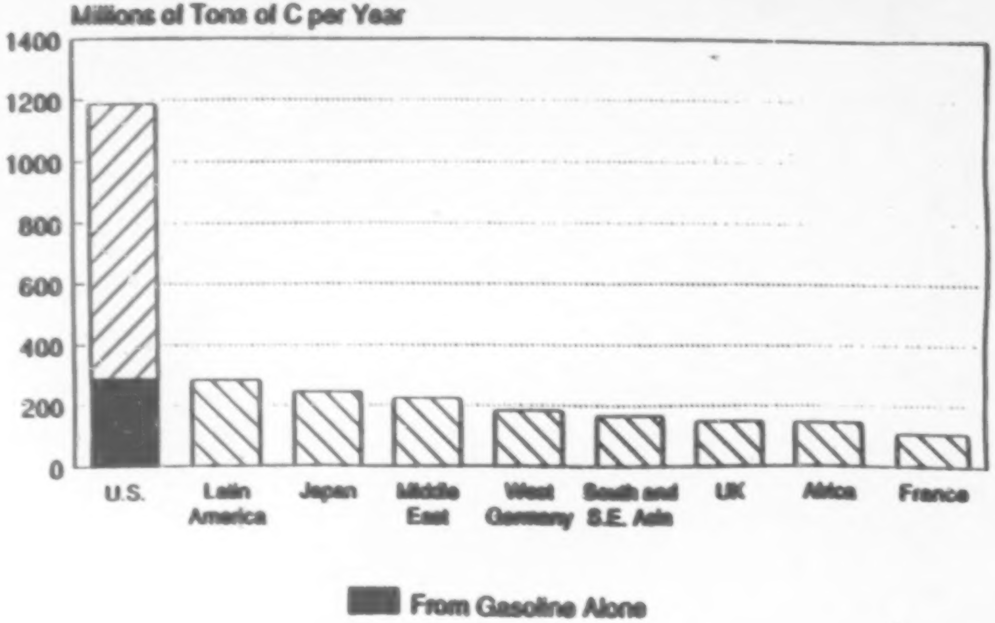
- While Chrysler expects to make a fair contribution to any meaningful effort to prevent global warming, the 50% reduction in CO_2 emissions already achieved (and the planned phaseout of CFCs) must be recognized as a significant technological accomplishment. Future additional reductions will clearly become increasingly difficult and costly.

- If the U.S. wants to reduce its output of CO_2, it should place a fee on all fossil fuels to encourage conservation and efficiency.

TGT1/Q1

Attachment B

U.S. CO2 EMISSIONS COMPARED WITH THOSE OF SOME OTHER REGIONS (1985)



Source: World Resources Report 1988-1989

Question 2

The automobile market is increasingly a worldwide market, for both U.S. and foreign manufacturers. Please state whether your company sells vehicles overseas, and, if so, the extent of your current sales and the trend you project in such sales for the future.

Chrysler's Response

Chrysler sells vehicles overseas that it manufactures in North America. In 1988, Chrysler exported 23,532 cars and was the leader in North American truck exports with 47,027 trucks exported from North America to the rest of the world. Significant growth in unit exports is expected; specific numerical projections depend on the value of the dollar, the level of demand growth overseas, and the openness of foreign markets to North American vehicles.

Question 3

Is the automobile market an expanding one on a worldwide basis? Do you foresee increased vehicle purchases and mile traveled for either the U.S. or the foreign consumer?

Chrysler's Response

In 1988, 46.6 million cars and trucks were sold worldwide, distributed as shown in the following table. Also shown are expected growth rates in unit sales.

	Percent of World Sales	Average Annual Growth in Units Next 10 Years
North America	37%	1.3%
Western Europe	31	1.5
Japan	14	1.8
Other Asia	5	3.8
Eastern Bloc	8	3.3
Other	5	3.5
	100%	1.8%

In the United States, average annual miles driven per vehicle has been growing at the rate of 0.2 percent per year since 1960. However, because the number of vehicles on the road has been growing by 3.5 percent per year, the total number of miles driven has risen by 3.7 percent per year over that period.

Some slowdown in the growth of total miles driven is expected in the future, especially if retail fuel prices rise toward levels attained in other industrial countries.

Overseas, the historical and expected patterns vary widely by country and region. The only statement that applies broadly throughout the world is that total miles driven have risen and are expected to continue to rise.

Question 4

Please list all vehicle models that you manufacture overseas, and all vehicle models that are produced through joint ventures between your company and foreign companies. Please state the volume of each model that is produced either overseas or through joint ventures, and the location of the manufacturing plants for each model. Include in your answser information on model years 1989, 1990 and projected information through 1995 if available.

Chrysler's Response

Chrysler does not currently manufacture vehicles overseas, though final assembly of knocked-down kits manufactured in North America is performed in several foreign countries.

The only vehicles Chrysler manufactures in joint venture with foreign manufacturers are assembled in North America. No joint-venture vehicles were sold prior to model year 1990. For 1990 model year, approximately 100,000 joint-venture vehicles are expected to be sold (Diamond-Star Motors).

TGT1/Q4

Question 5

Please state, for model years 1978 to the present, the percentage of your sales that are attributable to vehicles manufactured overseas. What percentage of sales from model years 1978 to the present are vehicles manufactured as joint ventures with foreign companies?

Chrysler's Response

Chrysler Vehicle Sales in U.S. by Source
(By Model Year)

	Traditional Domestic		Captive Imports*		Transplants**		Total	
Year	Units	%	Units	%	Units	%	Units	%
1978	1,959,571	94.5%	113,716	5.5%	---	---	2,073,287	100.0%
1979	1,678,000	89.6	195,616	10.4	---	---	1,873,616	100.0
1980	1,130,354	83.7	220,364	16.3	---	---	1,350,718	100.0
1981	1,126,787	86.5	176,434	13.5	---	---	1,303,221	100.0
1982	1,009,277	84.2	182,756	15.2	6,837	0.6	1,198,870	100.0
1983	1,164,916	80.0	162,521	11.2	128,338	8.8	1,455,775	100.0
1984	1,530,570	82.3	153,488	8.2	177,416	9.5	1,861,474	100.0
1985	1,864,110	86.4	170,231	7.9	122,131	5.7	2,156,472	100.0
1986	1,855,178	86.3	220,473	10.3	73,269	3.4	2,148,920	100.0
1987	1,795,770	86.9	235,836	11.4	34,838	1.7	2,066,444	100.0
1988	1,952,867	89.4	192,802	8.8	38,483	1.8	2,184,152	100.0
1989 (Oct.-May 20)	1,178,820	89.7	100,657	7.7	34,143	2.6	1,313,620	100.0

* Captive import manufacturers are Mitsubishi, Renault, and Maserati.

** Transplants are the Renault Encore and Alliance, Eagle Premier, and Plymouth Laser.

Question 6

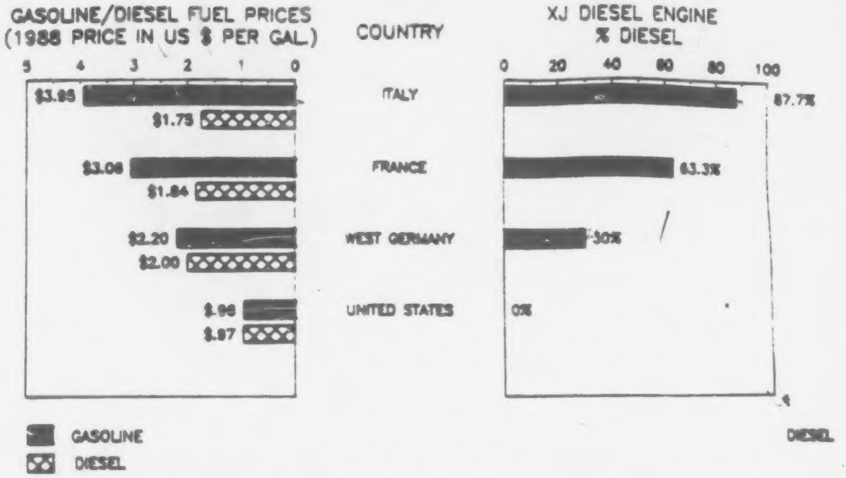
You have stated in your testimony that fuel economy is a low priority for new car buyers, citing the J.D. Powers 1988 survey, which found that only 3% of buyers listed fuel economy as the most important feature in buying a car. Yet other recent surveys indicate that Americans are increasingly concerned about the environment, and are willing to pay for environmental protection. For example, an April, 1989, analysis written by Lou Harris and others found that a majority of Americans believe this country needs tougher laws to protect the environment, and that more money should be spent to do so, even if it means raising taxes. Additionally, an October, 1988 opinion poll conducted for the communications consortium found that 77% of those polled favor raising fuel economy standards, even if it adds $500 to the price of a car. How do you square those results?

Chrysler's Response

- Chrysler's testimony did not indicate that fuel economy was a low priority but rather that fuel economy has fallen from #2 to #9 priority in buying motivation (reasons for buying).
- Relative to other recent surveys, we certainly agree that people in general are increasingly concerned about the environment. But answering survey questions can be quite different than "voting with dollars".
- New car buyers are not buying improved fuel economy. In fact, new car buyers are doing just the opposite . . . they're paying $600 or more for lower fuel economy engines with higher performance (Attachment D). They enjoy the higher performance, perceive gas to be cheap, and fuel economy of present product offerings to be reasonably good.

Attachment C

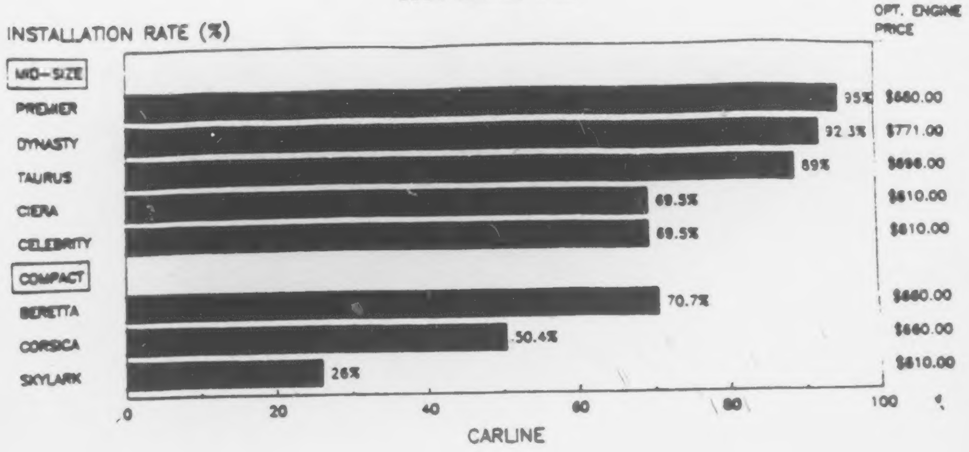
CONSUMER SUBCOMMITTEE TESTIMONY
XJ DIESEL ENGINE



NOTE: XJ DIESEL WAS DROPPED FROM THE U.S. MARKET AFTER 1986 DUE TO LACK OF CONSUMER DEMAND EVEN IN THE MOST RECENT YEAR (1986) THE DIESEL ENGINE MIX WAS ONLY .05%. (RETAIL PRICE OF $1507.00)

Attachment D

C.A.F.E. INFORMATION
V6 INSTALLATION RATES
1988 MODEL YEAR



Questions 7A

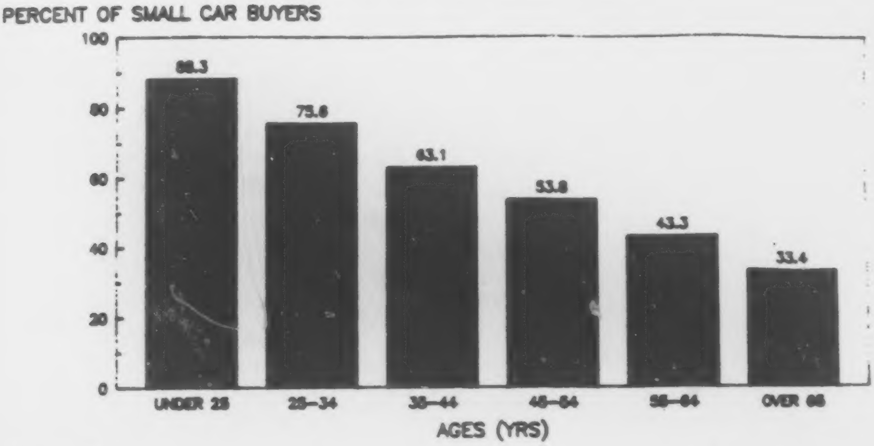
7A: Please provide any consumer or marketing survey or analyses performed by or for your company to ascertain consumer preference with respect to vehicle size, or to determine the effectiveness of emphasizing environmental issues or fuel efficiency in sales efforts within the last 10 years.

Chrysler's Response

- Chrysler's research indicates that consumer wants and needs, among other things, are a function of age and lifecycle.
  - As consumers age, marry, and raise a family, their needs change.
  - The mass of baby boomers are now moving into that lifestage where they will demand larger cars (Attachment E).
  - Whether they move up to cars as large as their predecessor generation did remains to be seen, but our forecast indicates that the trend towards midsize/large cars will continue through 2000 (Attachment F) as there is no incentive to move down in size, particularly as the population grows older.

Attachment E

CONSUMER SUBCOMMITTEE TESTIMONY
% OF SMALL CAR BUYERS BY AGE



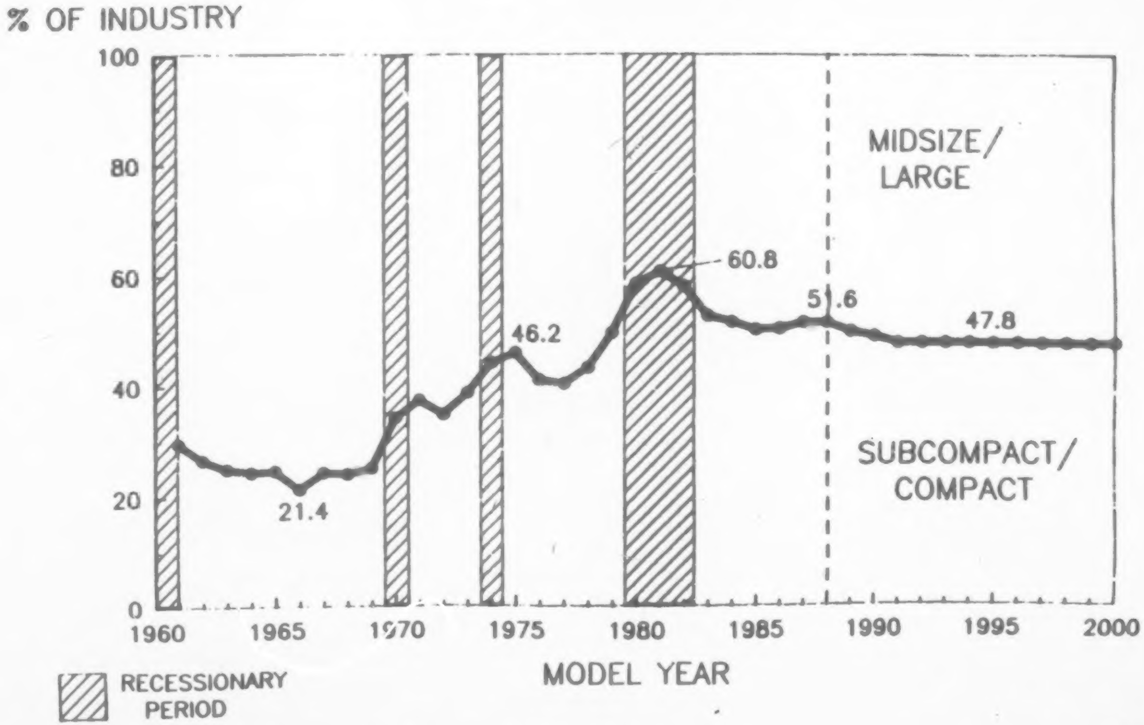
MEMO: % OF BUYERS	11.6	23.0	20.4	14.4	13.2	17.4

SMALL= SUBCOMPACT + COMPACT + SMALL SPECIALTY

1988 ROGERS 2ND QUARTER

Attachment F

CAFE
Industry Size Trend
Percent Share



SOURCE: CORPORATE ECONOMIST INDUSTRY 10/28/88
AND PROGRAM 05 5/4/89

5/30/89
(INDSIZE)

Questions 7B

7B: Please state whether any of your advertising efforts since 1980 have emphasized fuel efficiency or other environmental benefits of your vehicles. If so, please provide examples of such advertising.

Chrysler's Response

7B:
- Chrysler's advertising was strongly focused on fuel efficiency in the early 1980's.
- During the launch of the K-Cars in 1981 for example, our basic theme was "the American Way to Beat the Pump."
- This theme was carried in our print ads, brochures, at dealerships and especially on TV (see Video).
- And we stuck to this theme unfortunately much longer than we should have.
- Many in our company believe that our efforts nearly put us out of business a second time.
- While we continued to advertise small, four cylinder cars, many customers were demanding larger V6 cars.
- In essence, we were "at war" with our customers.
- As noted in previous testimony, the importance of fuel economy really peaked in 1980 when it was the second most important purchase reasons.
- In 1985, we ran this ad (Attachment G) opposed to reducing the CAFE standards.
- And as recently as May 22, 1989, this editorial (Attachment H) by our
- Chairman Mr. Lee Iacocca continued to urge legislation to stimulate consumer demand for fuel efficient cars.
- Attached is a listing of typical Chrysler advertisements encouraging consumers to buy our fuel efficient cars as a way to "beat the pump" (Attachment I).
  - . Also attached is a selection of seven additional print ads promoting Chrysler vehicles using fuel efficiency as lead lines (Attachments J-P).

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*/ The attachments were not reproducible.

Question 8

State the level of fleet fuel economy for both passenger automobiles and light truck, that you project will be achieved by your company between 1990 and 2000 if there is no change in Federal CAFE Standards.

Chrysler's Response

Chrysler improved its new car CAFE from 18.4 MPG in 1978 to 27.7 MPG by 1989 through significant downsizing, 100% front wheel drive and emphasis on 4-cylinder engines. Although gasoline prices declined, Chrysler has met the CAFE standard in the face of consumer demand for more power and pickup and riding comfort.

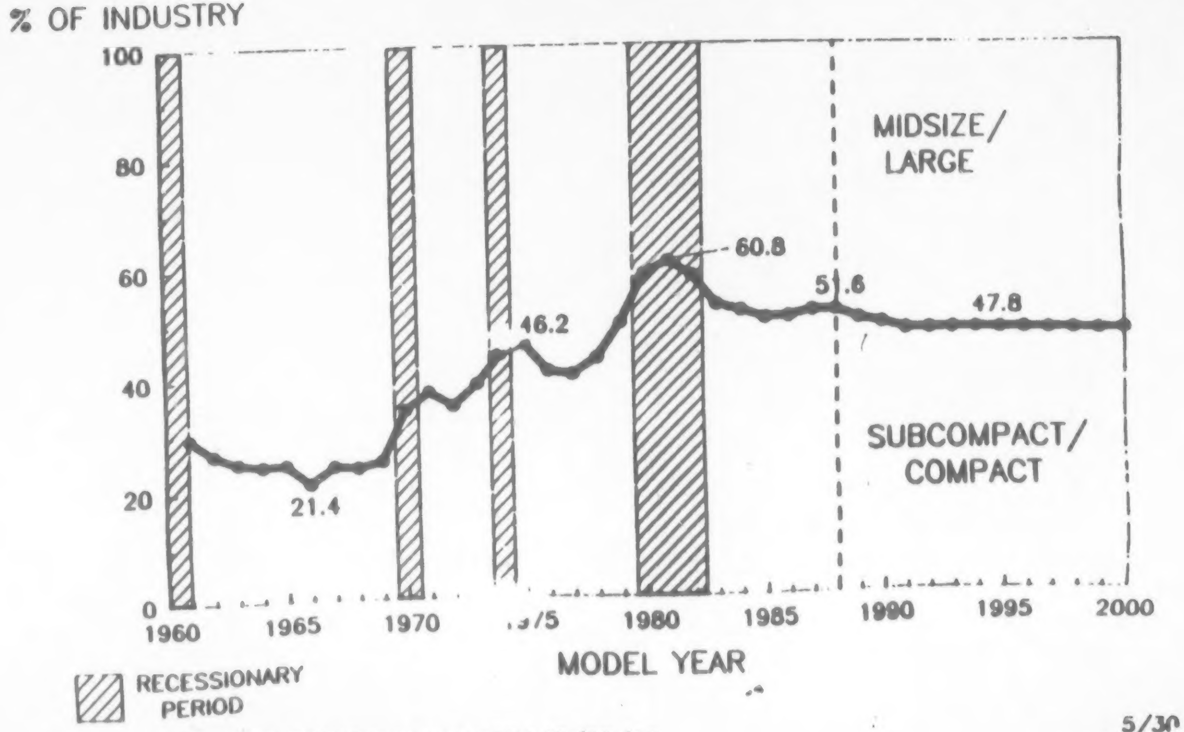
We project the market to continue to demand an increasing mix of large/middle cars versus compact/subcompact cars through the year 2000, given stable gasoline prices and no supply disruption or deep recessionary pressures. As Attachment Q shows, demand for subcompact/compact cars peaked at 60.8% share in 1981 and has steadily declined to 51.6% in 1988. We project subcompact/compact segments demand to remain slightly below the 50% share level through the year 2000.

Chrysler will meet the CAFE standard of 27.5 MPG through the year 2000 while remaining competitive in a market demanding larger, higher performing cars.

Attachment Q

CAFE

Industry Size Trend
Percent Share



SOURCE ORPORATE ECONOMIST INDUSTRY 10/28/88
ND PROGRAM 05 5 /89

5/30/
/IND

Question 9

State the range of your company's achievable levels of new fleet fuel economy by the years 1995 and 2000, for both passenger automobiles and light trucks, and the costs associated with achievement of each level. Include in your discussion the level that would be achieved assuming the maximum possible use of technology that is currently in production, and also assuming no performance loss or move to smaller vehicles.

Chrysler's Response

CAFE is influenced primarily by three factors:

1) The fleet mix of cars in large, middle, and small segments.
2) The weight of individual models in each segment.
3) The fuel efficiency technology of individual models in each segment.

Fleet mix and vehicle weight can readily be evaluated, but fuel efficiency is more difficult to assess.

The market's current insensitivity to fuel economy makes generalizations about fuel efficiency benefits of a specific technology uncertain. Technology that can improve fuel efficiency can also improve performance at the expense of fuel efficiency. Better fuel efficiency may be possible, but not marketable, either because it costs too much, or compromises the product, or both. The diesel engine is a good example of a fuel efficient technology that has been shunned by the marketplace for both reasons.

Continuing along these lines from the position that the market must demand, or at least tolerate, fuel efficient technology, then the maximum impact of current technology on fuel economy, within the constraints of marketability, is represented by the best models, in each segment, on the market today. The effect of diffusing current technology on Chrysler's CAFE results in a range of 28.5 - 29.5 MPG for passenger cars through 1995. Estimates have not been prepared for the year 2000.

Question 10

Please provide your views of the current structure of the CAFE standards, and any suggestions you have for improvement in that structure.

Chrysler's Response

A bill to amend the Motor Vehicle Information and Cost Savings Act was recently introduced in the Senate (S.1224) which proposes revisions to Corporate Average Fuel Economy (CAFE) standards.

Viewpoints concerning the efficacy of CAFE standards vary widely. Sponsors of the Senate Bill believe CAFE standards enacted in 1975 have been one of the most successful conservation measures in history, resulting in a doubling of the fuel economy of the passenger car fleet since 1975.

Other observers, including some manufacturers, believe CAFE standards had little direct impact on fleet fuel economy improvements. Rather, the improvements primarily resulted from market forces, including a rapid escalation of gasoline prices during the early 1980's, a shift in customer demand favoring fuel efficient vehicles and competitive pressures to fulfill these demands.

It is clear that, regardless of the underlying reasons, a doubling of fleet average fuel economy since 1975 is a remarkable achievement. If CAFE standards require revision to attain National energy conservation and environmental goals that cannot be accomplished solely by market forces alone, then the revisions should be structured in a manner that equalizes the improvement burden among all manufacturers, minimizes the potential for market distortions and reduces the potential to disadvantage domestic manufacturers offering a full range of vehicle types and sizes. Specifically, a percentage improvement approach equalizes the burden among all manufactures to pursue further fuel economy gains, and should result in a higher overall fleet average fuel economy level than an absolute CAFE standard.

Question 11

Please provide the amount, stated in dollars and in percentage of sales receipts, that your company has spent on research and development of fuel efficiency technology in each year since 1975.

Chrysler's Response

Research and development expenditures represent only a partial cost of bringing competitive, fuel efficient vehicles to market; expenditures for tooling, plant facilities and equipment, which are proportionally larger than research and development costs, are a necessary part of bringing any new fuel efficient vehicle and technology to market.

Chrysler does not maintain expenditure records in the manner requested.

Question 12

Please list any technological improvements related to improved fuel economy that have been used in production of vehicles in the light truck category since 1980.

Chrysler's Response (Light Truck Under 8500 lb. GVW)

Fuel Economy Technology Improvement	Introduction Year
Low Displacement Power Steering Pump	1982
Reduced Idle Fuel Consumption	1983
Increased Compression Ratio (.05 ratios)	1983
Energy Conserving Engine Oil	1983
Reduced Aerodynamic Drag (C_D) (Minivan vs. Full Size Van)	1984
ECU Controlled Engine Cooling Fan	1985
Convert all Bias Belt 15" Tires to Steel Radial	1985
Fast Burn A515 Replaces A511 Engine	1986
Add Part Throttle Unlock to A904 Automatic Transmission	1986
Fuel Injection Replaces Carburetor TBI	1987½, 88, 89
Fuel Injection Replaces Carburetor MPI	1987½
Convert 16½ Multi Ply Tires to 16" Steel Radial Truck	1987
Add 3rd Gear EC-Lockup to 3-Speed ATX Torque Convertor	1987½
Low O'Lap Camshaft and Roller Followers	1988, 89
A500 4-Speed Automatic Transmission RWD	1988
A604 4-Speed Automatic Transaxle FWD	1989
Light Weight Starters and Alternators	1988

Question 13

Please state the percentage of your passenger vehicle sales that are attributable to vehicles in the light truck category for each year between 1980 and the present.

Chrysler's Response

Figures shown below reflect car and truck volumes required to compute the new vehicle domestic CAFE fleets (cars/light truck) by model year:

					MEMO: Minivan	
M.Y.	Total Domestic Car Units	Light Trucks 1/ Units	Total CMC 2/	% Light Trucks	Units	% of Total CMC
1980	643,188	121,266	764,454	15.9		
1981	747,851	110,639	858,490	12.9		
1982	609,184	176,446	785,630	22.5		
1983	747,748	186,294	934,042	19.9		
1984	989,375	380,446	1,369,821	27.8	134,119	9.8
1985	1,136,123	514,222	1,650,345	31.2	241,880	14.7
1986	917,504	417,244	1,334,748	31.3	231,841	17.4
1987	1,178,424	786,449	1,964,873	40.0	283,300	14.4
1988	967,067	876,409	1,843,476	47.5	398,973	21.6

1/ Light trucks include units under 8500 lbs. GVW.

2/ Total CMC for domestic CAFE purposes = total domestic car + light trucks (i.e., does not include import cars and trucks and trucks over 8500 lbs. GVW).

Question 14

Please list the fuel economy standards achieved by your light truck fleet for each year from 1978 to the present. Please include in your answer your overall light truck fleet fuel economy average adjusted for the level of sales in each light truck category (the sales-weighted average across the fleet).

Chrysler's Response

Chrysler's light truck fuel economy from 1978 to the present is shown in the table below.

Model Year		CAFE Law	Domestic CAFE (MPG)	Import CAFE (MPG)
1978	C		- - - CAFE Reporting not Required - - -	
1979	C	17.2[1]	18.7	
1980	4x2	16.0	17.0	24.7
	4x4	14.0	14.1	
1981	4x2	16.7	18.0	24.6
	4x4	15.0	15.2	
1982	4x2	18.0		26.8
	4x4	16.0		23.5
	C	17.5	18.7	
1983	4x2	19.5		29.1
	4x4	17.5		26.7
	C	19.0	17.6	
1984	4x2	20.3		27.9
	4x4	18.5		25.2
	C	19.5	18.4	
1985	4x2	19.7		28.0
	4x4	18.9		24.6
	C	19.5	19.1	
1986	C	20.0	19.9	23.3
1987	C	20.5	21.0	22.3
1988	C	20.5	21.2	22.4
1989	C	20.5	20.8[2]	21.7[2]

[1] First year of standard, only applied to trucks in the 0-6000# GVWR class.

[2] Projected.

C Designates the combined 4x2 and 4x4 standard.

Question 15

Please state the effect of increases in CAFE standards on the competitiveness of the U.S. auto industry and the U.S. job market, assuming passenger car standards of 34 MPG by 1995, or assuming a 20% increase in each manufacturers' average by 1995.

Chrysler's Response

From 1985 to 1988 (calendar years), the fuel economy of all new cars sold in the United States increased by 1.3% per year, from 27.6 MPG in 1985 to 28.7 MPG in 1988. If the mix of cars sold had remained constant at 1985 levels, then the fuel economy of the new car fleet would have risen by only 0.9% per year.

Fuel efficiency by segment is as follows:

Car Segment	1985	1988	Average Annual % Change
Subcompact	33.1 MPG	33.1 MPG	0.0%
Small Specialty	28.4	26.6	-2.2
Compact	29.1	29.7	0.7
Basic Middle	26.0	27.7	2.1
Middle Special	24.4	27.8	4.4
Basic Large	23.5	25.4	2.6
Luxury	23.0	22.2	-1.2
Total Industry (Actual)	27.6	28.7	1.3
Total Industry (1985 Mix)	27.6	28.4	0.9

The slower improvement in fuel economy at constant 1985 mix is attributable to the buyers of luxury and small specialty cars (many of which are high-performance cars) demanding more options and more performance. These shifts in market demand partially offset increasing shares of subcompact and compact models.

Future gains in the fuel economy of new cars will come either from efficiency improvements within segments or from a shift in demand from heavier cars to lighter cars.

Efficiency Improvements

Gains in fuel efficiency within segments has slowed to 0.9% per year, on average, for the past three years, as shown in the above table. This calculation is important because it indicates the potential engineering advances that could be expected in the absence of market forces to shift buyers into smaller, lighter, more fuel-efficient cars.

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The efficiency improvements achieved before 1985 were greater than those since, but are less relevant to future fuel economy projections for three reasons:

- The easiest, most cost-effective technological improvements have already been incorporated into most vehicles (for instance, Chrysler's new car fleet is already 100% front wheel drive, so no further gains from switching from rear wheel drive to front wheel drive can be achieved).
- Prior to 1985, each segment underwent varying degrees of downsizing (for instance, the typical large size car today is about the size of a basic middle car ten years ago).
- Manufacturers that already met the fleet average CAFE because they sold only small cars had no incentive to make improvements. Indeed, the CAFE for imported cars was less in 1988 than it was in 1983.

Downsizing

Clearly, unless there is a significant technological breakthrough in fuel efficiency in the next year or two, the attainment of a 34 MPG average from new cars by 1995 must come from further downsizing of the fleet. Downsizing has two dimensions:

- Reducing the weight of cars in ech segment while maintaining the approximate size of today's cars.
- Shifting sales from a large car segments to small car segments.

Weight Reduction

One way of reducing the weight of vehicles is to substitute light-weight composite materials for heavier materials. The cost of making such substitutions on the scale significant enough to affect the new fleet fuel efficiency would take the prices of new cars well beyond the reach of the ordinary citizen. We consider this alternative to be neither feasible nor desirable.

Another way is to install smaller engines and reduce performance by enough to meet the higher mileage standard. Without an incentive to purchase the new low performance, high MPG cars, the car buyer would be steered toward buying and maintaining older, used cars that offered better performance. Such an incentive would run counter to the desire of achieving more fuel efficiency.

Segment Shifts

If the one-percent average technological improvement in fuel efficiency within each segment is achieved, then in order to meet a 34 MPG standard by 1995, 65% of the vehicles sold would have to be subcompacts, with the remaining 35% consisting only of compacts - - the next most fuel efficient segment. (Of course, if a higher percentage of subcompacts were sold, a small number of cars larger than compacts could also be sold and the 34 MPG CAFE still met.)

In calendar year 1988, sales of subcompact cars totalled 2.504M, of which 80% (1.993M) were manufactured by foreign manufacturers (including transplants). In the compact segment, 2.056M cars were sold, of which 42% (857 thousand) were foreign made (also includeing transplants). For the total of the two segments, which comprised 43% of all car sales in 1988, 62.5% of cars sold were made by foreign companies.

Effect on Competitiveness

The effects on competitiveness, jobs, and the trade deficit of requiring all car manufacturers to meet a set standard versus giving each manufacturer an equal task by requiring the same percent improvement from each (perhaps with ceilings and floors) are quite different.

With the exception of the luxury car makers in Europe, foreign car manufacturers make predominantly small cars. The reasons for this pattern are various: geography (distance between cities), cultural habit, and operating costs -- principally gasoline prices. The differences of gasoline pump prices among countries is well-known, averaging more than three times the U.S. price in Europe and Japan. This situation has existed for many years.

Consequently, foreign vehicle manufacturers have specialized in making small cars and are far down the learning curve compared with their U.S. competitors. Fully 95% of the cars registered in Japan are in the compact and subcompact segments, while 80% of European car registrations are in the same segment. In the United States, the comparable figure is 43%.

As a result, foreign car manfacturers have captured large shares of the subcompact and compact segments in the United States. A requirement that each manufacturer meet a 34 MPG standard by 1995 puts a disproportionate burden on the three traditional U.S. car makers -- requiring more than a 4% per year improvement in efficiency. This improvement can be achieved in such a short time period only by abandoning the manufacture of today's mix of cars and shifting to the production of small cars. Because of the historical dominance of foreign car manufacturers in the small car segments, significant market share would be lost by domestic car makers.

We assume that total car market demand in 1995 is ten million units and that the traditional domestic manufacturers are able to preserve their current market shares in the subcompact and compact segments. We also assume that they will be able to sell only compact and subcompact cars will be sold.

Allowing the full utilization of transplants in place by 1995, production of cars by traditional domestic manufacturers will drop by more than 2.2 million in 1995 and imports of built-up cars will exceed 4 million units. The higher level of built-up imports and transplant production, which consists of 40% imported parts, will result in a deterioration in the trade deficit of more than $26 billion from the level it would have reached without the 34 MPG edict. Reduced domestic employment from the loss of share by domestic manufacturers will amount to 200,000 direct jobs in the auto industry in 1995 and an additional 340,000 in support industries.

The alternative of requiring each car manufacturer to achieve a 20% improvement in fuel efficiency by 1995 would put equally but very severe strains on all companies. Technological improvements alone are not sufficient to raise fuel economy 20% by 1995. Downsizing will also be needed. Therefore, we believe that a 20% increase in CAFE by 1995 is infeasible based on known technology.

However, assuming a technologically feasible percentage increase task is required of each manufacturer, this concept versus a fixed higher-level standard, has several advantages.

- It allows consumers a wider choice of vehicles at affordable prices.
- Since all manufacturers would be required to make improvements in fuel efficiency, more total effort would be devoted to the task, raising the likelihood of future technological progress and assuring maximum gains in total fleet fuel efficiency.
- The attendant effects of higher fuel economy on domestic manufacturers, jobs, and the trade deficit would be less deleterious.

QUESTIONS OF SENATOR BREAUX AND THE ANSWERS

Questions 1A & 1B

If I understand you, government policy zigzags on the maintenance of auto fuel consumption standards, allowing interest in standards to vacillate with public whim, have caused more problems than any firm implementation of the CAFE standards set in 1975:

1A: How can the Congress now undo the problem that it has helped to create?

1B: What should government do to try to redirect public choice and interest in maintaining firm policies for fuel consumption reduction?

Chrysler's Response

With respect to implementing the CAFE standards themselves, the Congress was not the problem. Once the standards were set by the Congress in 1975, automakers knew what their tasks were and could set about to meet them.

The disruption, at least for Chrysler, was that we had structured our product mix so as to meet and, in fact, exceed the CAFE standards each year. Rising incomes and falling gasoline prices in both real and nominal terms caused a rise in the demand for larger, more option-laden, more powerful and therefore, less fuel efficient vehicles at the same time that the Reagan Administration chose to roll back the CAFE requirements from 27.5 MPG to 26.0 MPG for the years 1986-1988. As a result Chrysler was caught short of the vehicles that were in strong demand and had to revise its product strategy quickly. Because changes in product plans require several years to be realized, we had to take a number of stop-gap steps including the costly importation of V6 engines.

Thus, one action that the Congress can take if it revises the CAFE standards is to provide long enough lead times for vehicle manufacturers to respond sensibly. Another is to act so as not to put the domestic automakers at a competitive disadvantage and thereby, worsen the trade deficit. The automotive trade deficit constitutes more than 40 percent of our merchandise trade deficit and shows few signs of improving in the near future.

One option Congress could consider is requiring that adequate lead time be given on any rollback so as to permit all manufacturers to make some adjustment in product mix to benefit from lower standards.

Finally, we believe that the Congress should take a more holistic approach to policy and act not only to affect the supply of vehicles so as to benefit the environment and reduce our dependence on imported oil, but also should affect the demand for those same vehicles through appropriate fuel pricing. Not dealing with both sides of the supply-demand balance invites inefficient and inequitable distortions in our industry and competitive structure. For this reason, we strongly support higher gasoline prices (through taxes) if the CAFE standards are to be raised.

Question 1C

We hear of new automotive technology, multi-valve engines, electronic transmissions, fuel injection, etc., can you achieve significant increases in fuel economy without downsizing your fleet?

Chrysler's Response

Defining the term "significant" is perhaps critical to the understanding of this question. If the CAFE improvements of the industry since 1978 are reviewed, it is observed that the new car fleet fuel economy improved at a rate of 3 to 4% per year during the period from 1978 to 1985, the original year for the achievement of the statutory 27.5 MPG standard.

This period represents the era of rapid downsizing of the U.S. fleet. For example, Chrysler's domestic car fleet inertia weight decreased by approximately 500 lbs. This led to "significant fuel economy improvement".

During the period from 1985 to 1989, the U.S. fleet fuel economy has improved at a rate of about 0.5% per year. This is during the time period that much of the technology identified has been introduced into the U.S. fleet.

It is probably unlikely, with the atmosphere of low cost fuel and consumer preference for performance, that such technologies have been optimized for fuel economy and gains in excess of 0.5% per year could be realized.

Higher specific output engines with lower displacement, continued refinement of electronic controls, both for engines and transmissions and associated technological improvements can improve fuel economy, without downsizing, at a rate of 0.5% to 1.0% per year between now and 1995. More significant improvements in the near term would require mix changes or vehicle downsizing.

Questions 1D & 1E

Your statement claims that "U.S. producers shoulder a disproportionate share of the burden of increasing overall automotive fuel economy.

1D: Explain in some detail the implications of this statement? If all U.S. producers are subjected to the same rules, where are the problems?

1E: What do you mean by "disproportionate"?

Chrysler's Response

Although a uniform CAFE standard appears benign, in reality it is an advantage to import manufacturers. When the CAFE law was first enacted in 1975, the fleet fuel economy of the domestic manufacturers was 14.8 MPG, and by 1988 it was 27.3 MPG. For the import manufacturers, fleet fuel economy was 23.3 in 1975 and increased to 31.2 MPG by 1988. This translates into a 34% improvement in fuel economy for the imports versus an 85% increase in fuel economy by domestic manufacturers. Therefore, the domestic manufacturers have had a greater task to comply with the standard due to the variety of cars they produce. Also, CAFE for import manufacturers has declined since 1983, whereas the domestic manufacturers' CAFE has increased.

This is only one example of how the U.S. domestic manufacturers were required by the CAFE standards to "shoulder a disproportionate share of the burden of increasing overall automotive fuel economy." Attachment A graphically illustrates the inequitable burden shouldered by the domestic manufacturers. As the graph shows: the fuel economy of the import manufacturers was higher than the domestic manufacturers in 1978; the domestic manufacturers have consistently increased their fuel economy over time, the fuel economy of the import fleet has decreased since 1983; and the total fleet fuel economy parallels the gains of the domestic manufacturers. Obviously, the domestic manufacturers have had more of an impact on the total fleet fuel economy gain than the imports.

Further, domestic manufacturers must divide their fleet into two segments, import and domestic. Since the domestic import fleet generally consists of fuel efficient subcompact vehicles, domestic manufacturers do not receive any CAFE benefits associated with selling these vehicles.

Attachment A

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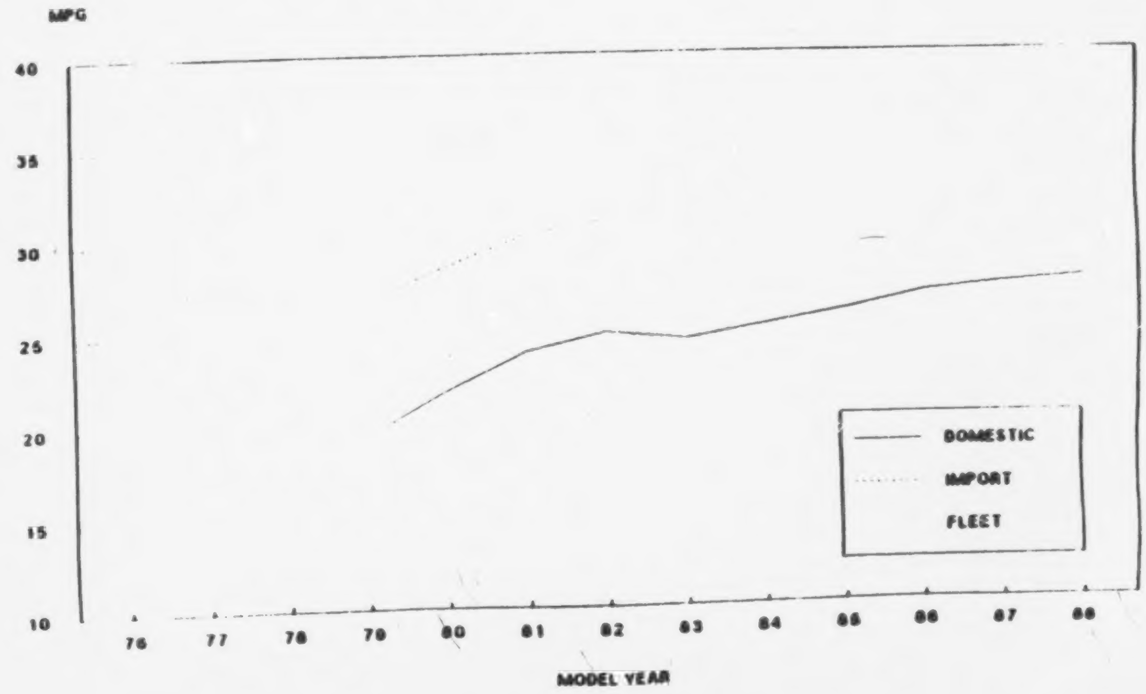

Fig. 1 Fuel Economies of Automobiles, Model Years 1976-1988; October 75 through March 88

Senator **Bryan**. Thank you very much, Mr. Liberatore.

Dr. Whitman, much of your prepared testimony, or at least a good part of it, suggests that increasing CAFE standards will alter consumer lifestyles, will have a disruptive effect upon the market. And I must say that those arguments sound a bit deja vu.

That was in effect what the industry was saying in 1975 when CAFE was adopted. The corporate average fuel economy in 1975 was about 14 miles per gallon. Today it is 26.5 miles per gallon, with the waiver granted by the previous Administration.

Has not CAFE been a marked success in terms of reducing fuel and as a consequence also helping us in terms of our environmental problem?

Dr. **Whitman**. Well, Senator, the only serious economic studies I know of indicate that those improvements in fuel economy—and indeed ours did improve by some 130 percent—were due not to CAFE, but to changes in energy prices and perceived energy availability.

So throughout most of the period, the best evidence I know of, independent studies, suggest that CAFE was not relevant. At some point, of course, when energy prices dropped, CAFE did become binding on the domestic producers. But there again, there is no evidence that it became binding on the consumers.

Clearly, as I say, it can make a difference and it can constrain some producers and not others. So far indeed, the Japanese, who are unconstrained by CAFE, have been more than ready and willing to step in, in some cases, with vehicles which are less fuel efficient than those domestic vehicles that they are competing with. And the consumer has had a continued wide range of choice, but there have become constraints on the domestic producers.

Senator **Bryan**. Dr. Whitman, with the greatest respect, I am not persuaded that CAFE has not had a substantial impact. Senator Breaux I thought made a rather persuasive observation in the colloquy that he had, that today really in terms of the cost of living increases that have been experienced, gasoline prices are relatively cheap by way of comparison with what they were 10, 15 years ago.

So my own view is that CAFE has had quite an impact.

Let me ask, Ms. Petrauskas. You have made what I think the lawyers would say is the de minimis argument, that really the automobile does not have that great an impact and there should be a national policy related to global warming.

I do not disagree, Ms. Petrauskas, with the observation that we ought not to single out the automobile companies alone and say, we have solved our environmental problem, we have addressed our energy dependency problem. But you perhaps had a chance to see that chart that I presented to the previous witness, which indicates that if you look at gasoline CO_2 emissions from the United States alone, that that would equal or exceed the total CO_2 emissions from Latin America, Japan, the Middle East, West Germany—I am trying to read there at a distance—Africa, the United Kingdom.

That says to me that gasoline emissions and the CO_2 that is derived from them are a substantial part. I do not want to argue all or the only problem. But that suggests to me that that is a basis which the Congress ought to at least have as a frame of reference in undertaking its action.

One other statistic that has been shared with me that I would invite your comment, if I have been misinformed, that the rollback from 27.5 miles per gallon to 26.5 miles per gallon over the lifespan of that model year in effect causes 18 million tons of additional CO_2 in the environment. That strikes me as a rather substantial amount.

Could I get your comment or response to those two observations?

Mrs. **Petrauskas**. Mr. Chairman, if I may ask the committee's permission to address both the chart and your specific question for the record.

Senator **Bryan**. Certainly.

Mrs. **Petrauskas**. Let me try to explain what we meant when we pointed to the potential benefit of doubling CAFE. If, as I said, if we look at the European fleet, and that is somewhere at 31 and it looks a lot different from what Americans are used to driving, and then we say we really want to go to 35 or 40, and even higher numbers have been suggested, at the very least we ought to ask ourselves, is there some other thing we ought to do first.

We are saying clearly we ought to have control of CFC's first; and second, we are saying it looks like alternative fuels have promise. Ought we not throw that into our debate, ask ourselves if that is a potential answer, before we take what I think I can fairly characterize as a drastic step in changing what personal mobility looks like in this country?

That was the thrust of our remarks.

Senator **Bryan**. Just so that our record might reflect that, do I read the chart correctly? And you cannot see it. We are really not trying to hide that from you, Mrs. Petrauskas.

Could we give the witness——

Mrs. **Petrauskas**. The summary kind of numbers in terms of contribution to potential global warming gases that I am familiar with say, if one looks at all global warming gases, about 2.5 percent of those are as a result of vehicles in the U.S., about 2.2 percent is a result of vehicles elsewhere, 13 percent on a worldwide basis is petroleum usage, but it is not vehicular petroleum usage.

That is not to argue that automobiles are not part of the equation. They are. But those are sort of the relative contributions.

Senator **Bryan**. Now that you have been provided the chart, could you comment as to whether you agree or disagree with those numbers? And also with respect to the 18 million tons of CO_2 as a result of the waiver of one mile per gallon over the life expectancy of the fleet manufactured in that year?

Mrs. **Petrauskas**. As I indicated, Mr. Chairman, if I may, I do not want to try to do the calculations as I sit here, so we will provide that for the record if we may.

Senator **Bryan**. Sure, if you will, please.

I see that my time is up, and we may be called upon for a vote shortly. So I will yield now to the Ranking Member, Senator Gorton.

Senator **Gorton**. Mr. Liberatore, I am looking at two I think quite valid points that you make on pages 3 and 4 of your testimony. The first is that you are locked into product plan decisions for 1993 and 1994 that assume combination of present governmental policies, and I suspect that is true for the other two witnesses as well.

On the next page, you point out that fuel prices and consumer expectations have more impact on fuel efficiency than do CAFE standards.

What assumptions with respect to fuel prices went into those decisions about your 1993 and 1994 product mix?

Mr. **Liberatore**. That fuel prices would rise more or less equally with inflation. We did not expect a spike in fuel prices.

Senator **Gorton**. So that you would not expect the consumer ordering of priorities, which now has fuel efficiency ranked ninth, to be much different in 1993 or 1994?

Mr. **Liberatore**. That is correct, Senator.

Senator **Gorton**. And if in fact you are wrong and fuel prices double or more in real terms between now and that year, you are going to be in deep doo-doo, are you not?

Mr. **Liberatore**. I would say we would have to scramble under that scenario. But we do not expect fuel prices to double over the next three or four years.

Senator **Gorton**. And in fact, if it were the belief of this Congress or this committee that fuel costs are going to increase substantially over the next several years, you might well be helped by an early signal that CAFE standards were going to force you into a decision which you do not believe at this point the market will force you into?

Mr. **Liberatore**. Well, as you will see in other places in my testimony, I do suggest that CAFE can serve as a useful safety net, in effect, under the market.

Senator **Gorton**. You just want it to be reasonable?

Mr. **Liberatore**. That is right.

Senator **Gorton**. Dr. Whitman, let me ask you a very close relative to the same question. Let us say we do absolutely nothing here to change CAFE standards. We have this hearing and that ends it, and let us say that you could even be assured that between now and the year 2000 we would not change those standards.

What would your prediction be as to your average fuel economy standards of General Motors' fleet at that point?

Dr. **Whitman**. Senator, there is no way that I can possibly tell what the fuel economy would be in the year 2000, partly because, as I say, a major determinant of that is fuel prices and fuel availability, and those are both well beyond our control.

We currently have right now in our fleet automobiles with fuel economy ranging from 65 miles per gallon down to about 23. All of those are available now to consumers. The mix of those that they choose is heavily dependent on fuel prices and fuel availability.

Secondly, of course, I cannot tell now the extent—the rapidity with which it will be possible to disseminate the technologies that we already are introducing in our fleets, how rapidly it will be possible to disseminate those in terms of consumer acceptance.

Nor can I tell—I know there are no big breakthroughs on the horizon, but I cannot tell exactly what will prove out and when.

If I may very briefly, Senator, address the question you asked Mr. Liberatore, and you said, "you would be in deep trouble if energy prices were to double and you did not expect it." That of course is true.

However, it is symmetrical. We got in deep trouble in some cases because we anticipated higher energy prices, we downsized our fleet to match that prediction, and when energy prices were lower we had certain cars that the consumers simply would not accept, our Seville, Toronado, Eldorado, and so forth.

At enormous expense, we had to redesign those cars to make them acceptable to the consumer under the price scenario, the price situation which actually prevailed.

Senator GORTON. By the same token, if we were to impose a carbon or greenhouse fee to all fuels, which both you and Ms. Petrauskas have advocated, in any substantial amount, an amount sufficient to change habits so that it would lower those emissions, that would also have a tremendous impact on your vehicle mix, would it not?

Would that not be very likely to drive fuel costs higher in the consumer's view?

Dr. WHITMAN. It certainly would have an impact, Senator, and I believe we advocated that there be a serious discussion of that possibility, and I think that discussion should take account of the cost side and the impact on lifestyle side, as well as the benefits.

But all one can say is that the impact on this one industry would clearly be less drastic if all sources of fossil fuel emission were captured than if the attempt were made to get any given degree of improvement by targeting only this one activity. As Mrs. Petrauskas has said, you could eliminate the U.S. car and truck industry and you would still have 97 percent of the CO_2 emission that you had before.

Senator GORTON. I think it is time to vote, Mr. Chairman. I am going to give up.

Senator GORE. Mr. Chairman, could I just say that I would recommend that we—even though I have not had a chance to ask questions, I will submit questions for the record so that this panel can be dismissed, and then we can start with the next one when we come back.

I would just like to say that I think that de minimis arguments are not going to be acceptable, because when we approach countries like Brazil or Japan, whatever, and say this, this, and this has to be done on the problem, they say, well, you are not even doing anything about this graph here, you are not even willing to, you are lowering your mileage efficiency standards.

We lose any moral authority to exert leadership in the world if we do not act ourselves.

Thank you, Mr. Chairman.

Senator BRYAN. Thank you very much, Senator Gore.

This subcommittee will be in recess for 20 minutes.

Senator Breaux has some written questions, Mr. Liberatore, for Chrysler and would appreciate your response. Other committee members may have some additional questions.

We are going to excuse this panel. I know you have got to catch a plane, Mrs. Petrauskas. We appreciate your participation this morning.

The subcommittee will reconvene in 20 minutes for the third panel. Thank you.

[Short recess.]

Senator BRYAN. The subcommittee hearing will reconvene.

Panel 3 will consist of: Ms. Deborah Bleviss, the Executive Director of the International Institute for Energy Conservation; Mr. Marc R. Ledbetter, the Senior Associate, the American Council for an Energy Efficient Economy; and Mr. Clarence Ditlow, the Executive Director, Center for Auto Safety.

Let me preface my comments by apologizing to the panel for delay, but we were called for two roll call votes that the subcommittee could not miss.

Ms. Bleviss, let us begin our testimony with you.

STATEMENT OF DEBORAH BLEVISS, EXECUTIVE DIRECTOR, INTERNATIONAL INSTITUTE FOR ENERGY CONSERVATION

Ms. BLEVISS. Thank you very much.

I am going to summarize what I have stated. As you can see from my testimony, it is rather lengthy. I would just like to pick up a few of the points and I hope that in questions we will be able to pick up some others.

Let me note first of all that the comments that I am making are culled from a study I conducted from 1985 through 1987, which looked at a lot of the issues this committee is addressing right now: the technological feasibility of improving fuel economy in the automotive industry and, based on that assessment, what types of policies are needed to expedite the process of increasing fuel economy.

That study, by the way, was published as a book called "The New Oil Crisis and Fuel Economy Technologies" last year.

I would like to address a couple of points which your staff has asked me to address from that book. The first one has to do with the technological feasibility of improving fuel economy, and the second has to do with a subject that has been raised in the hearings today very frequently—the competitiveness issue.

Very quickly, I would like to point out that the study that I conducted, much to my surprise and many of the reviewers in my study, revealed that the technology revolution of the last decade—plus that has occurred mainly in the space industry and the defense technology is only now being applied to automotive technologies.

And in fact, there are a plethora of potential technologies under development which could be applied to the automobile. Unfortunately, what that study revealed is that disproportionately the application of those technologies to the automotive industry is being looked at by our competitors overseas and not here in the United States.

In fact, I am intrigued repeatedly that whenever I testify or make a public statement, I still get calls from companies that have developed a product here in the United States, cannot get the "Big Three" to pay attention to them, and are wondering what they can do other than go overseas and find somebody to pay their way overseas.

This is a major problem in this country and one that I think plays very directly into the competitiveness issue.

Now, when can those technologies come forward and what can they produce? Well, you will note that the first table I show in my testimony is a guess on my part under an accelerated program of when the technologies could come forward.

As you will note, there are quite a few. I might note, this is an aggressive effort, this is assuming an aggressive effort by our automotive industry. But you can see that there are quite a few that could come forward by the turn of the century, that, is enter into production in some state—not across all car lines but in some car lines—by the end of the century.

In addition to these, there are quite a few others that could potentially see the light of day by the beginning of the next century.

What types of fuel economy could they yield? There have been some references already to prototypes, some denigrating, some more positive. But in fact the Europeans did launch in the early eighties a fairly aggressive program of developing fuel efficient prototypes in anticipation of a new oil crisis.

Those prototypes yield very astonishing fuel economies. Generally, they are in the upper 50's to low 60's in terms of city fuel economy, in the 80's in terms of highway fuel economy.

Many have argued that of course you can produce a fuel efficient car, but that car will do little else other than get better fuel efficiency. It will be too small. It will not accelerate well, et cetera.

In response to this argument, one of the most interesting prototypes that is shown in table 2 is the Volvo car, which is called the LCP-2000. I point to the Volvo because it was designed not to be merely a fuel efficient car. It was designed also to be safe, it was designed to have relatively low emissions (especially by European standards), and it was designed to be an attractive car and to have very attractive acceleration.

The point of these prototypes is to show that, first of all, you can produce very fuel efficient cars; and secondly, you need not sacrifice other consumer desires to do this.

Now, very quickly I would like to point out the last table, and that brings up the issue that I raised before, that the research in a lot of these technologies is occurring very much disproportionately overseas, and particularly in Japan.

The concern that I would like to raise for you is, let us look into the 1990's and let us presume that, for a variety of reasons, we have to look at increased fuel economy. It may be because of a new oil crisis, it may be because of government action with regard to global warming. In either case, the question is who will meet fuel economy requirements more readily? Will it be us or will it be our competitors?

You can see, based upon the technology listing, from the research points of view, it is not likely to be us at this point. We are lagging our competitors, particularly the Japanese, in most of the fuel efficient technologies under development.

Another way we could respond to fuel economy demands is by selling small cars. There were a lot of comments about small cars today by the automotive panel. But in fact, if you look at what is happening to the small car production bases in this country, they are not staying in this country. They are going overseas.

In fact, the Metro, which was the small car model that was cited by General Motors, is not produced by General Motors. It is produced by Suzuki and it is marketed by General Motors. So in fact, if a crisis comes or if there is a demand for high fuel economy in the 1990's, if the manufacturers turn to small cars rather than fuel efficient cars, they will be at the mercy of their suppliers.

They will not have the manufacturing base in this country to meet that demand themselves.

Senator GORE. They will have a little bit in Tennessee.

Ms. BLEVISS. Right, that is right. The Saturn is about the only commitment that we have had, that is right. I am talking about the American manufacturers.

The other comment that I would like to make is, what can we do about this? And very quickly, I have listed a lot of the types of policy changes we need to look at. But standards has to be at the core of the policy changes. We also have to look at consumer incentives, but we do have to look at standards as well.

The types of standards that we address should be in many ways different from the types of standards that we have used in the past. The percentage approach that many people talked about is a wise approach. It makes a lot of sense for a lot of reasons.

But we do have to be committed to fuel economy regulations, and we cannot allow rollbacks. We cannot allow abuse of the regulatory system, as we have allowed in the last few years here, because if we allow that then the regulations will not mean anything in any case to the automotive companies.

Thank you.

[The statement follows:]

STATEMENT OF DEBORAH LYNN BLEVISS, EXECUTIVE DIRECTOR, INTERNATIONAL INSTITUTE FOR ENERGY CONSERVATION

Mr. Chairman and Members of the Subcommittee, thank you for inviting me to speak today on the subject of light vehicle fuel economy. The comments I will make today are culled from a study I completed between 1985 and 1987, which assessed what technologies are currently under development that could boost automotive fuel economy by the end of the century, the status of that development, and what could be done to accelerate this development. That study was published last year by Quorum Books under the title The New Oil Crisis and Fuel Economy Technologies: Preparing the Light Transportation Industry for the 1990s.

In my testimony today, I would like to address three issues: the technical feasibility of improving light vehicle fuel economy; the effect on the U.S. industry's competitiveness if the fuel economy of its fleet is not significantly improved; and finally, necessary policy changes to improve light vehicle fuel economy.

TECHNICAL FEASIBILITY

When the first fuel economy standards were legislated in 1975, many doubted that the fuel economy of the American fleet could be changed as rapidly as the standards proposed. Yet, ten years later, the average fuel economy of new American cars was nearly double what it had been a decade before.

Now similar questions are being raised about the technical feasibility of raising fuel economy requirements again. Many argue that we have "maxed out" on being able to make further improvements in fuel economy.

In truth, however, just the opposite is true, for the materials and electronics revolutions that have spawned such marked changes in space and defense technologies are just now being applied to light vehicles (automobiles and light trucks). Indeed, the enormous strides seen in the past decade in improved light vehicle fuel economy have resulted primarily from optimization of existing technologies rather than application of new ones.

Before summarizing the types of new technologies under development that could further improve light vehicle fuel economy, it is appropriate to review where energy losses occur in today's modern light vehicle so as to be able to assess where the opportunities for efficiency improvements lie. Vehicle fuel is converted to useful work in the engine, where its combustion is used to turn the crankshaft. Seventy to eighty percent of the fuel's energy content is lost directly at this point to coolants, exhaust gases, convection and radiation. Much of this loss can be reduced, but thermodynamic laws dictate that generally over fifty percent of the energy content of a fuel cannot be recovered.[1]

Crankshaft energy is then transmitted to the vehicle's wheels through the transmission, with further losses occurring along the way. Today's manual transmissions, when driven optimally, have efficiencies of 90 to 95 percent with the increasingly popular automatic transmissions enjoying lesser efficiencies of 80 to 85 percent. Some crankshaft energy--about ten percent over a typical driving cycle--is also used to operate the vehicle's accessories, including its air conditioner and alternator.

Once power reaches a car's wheels, it must be used to overcome the aerodynamic drag of the vehicle (as determined by its drag coefficient, frontal area, and speed) and its rolling resistance (as determined by the friction of its tires, the road surface, and the vehicle's weight). In addition, energy is lost in braking. In urban driving, the fraction of energy dissipated by each of these functions is about equal--one-third each for overcoming aerodynamic drag, overtaking rolling resistance, and braking. On the highway, however, the fraction of energy used to overcome aerodynamic drag rises to more than 60 percent, while less than 10 percent is dissipated in braking.

Hence, the opportunities for reducing the fuel consumption of a vehicle lie in improving the efficiency of its engine and transmission; reducing its weight, aerodynamic drag, and rolling resistance; improving the efficiency of its accessories; and lessening the energy dissipation of braking.

New opportunities are now arising for improving the efficiency of engines. The advent of electronics and better sensor technology, for example, has enabled the development of ultra-lean-burn gasoline engines in which very lean air-fuel mixtures can be burned in low load conditions; Toyota has already developed such an engine for commercial use, finding a 20 percent improvement in fuel economy.[2] Similarly, the development of ceramics has facilitated the evolution of "adiabatic" or "low-heat-rejection" diesel engines which may eventually obviate the need for any engine coolants. If the waste energy of the exhaust gases from such engines can be effectively recovered, fuel efficiency improvements of 30 to 60 percent (compared with today's gasoline-powered vehicles) may be possible.[3] Technology strides are even bringing back the stratified engine for re-evaluation. While such an engine is multifuel-capable and enjoys an efficiency comparable to a diesel, its widespread use has been hampered in the past by high emissions rates. Improved combustion techniques, however, in combination with better electronic controls promise to reinvigorate interest in this engine, possibly as a two-stroke, rather than conventional four-stroke, machine. In fact, Ford Motor Company has recently signed a licensing agreement with the inventor of a high technology, two-stroke, stratified charge engine.[4]

Similar opportunities for efficiency improvements are arising with transmissions. Electronics advances have enabled better coordinative control of the transmission with the engine so as to maintain the latter in its more efficient full-load state as much as possible. Even more advanced has been the development of better conventional automatic transmissions. These are characterized by having more gears--hence maintaining the engine in full-load for a larger fraction of operations--or by lock-up clutches on all gears--hence reducing frictional losses of the torque converters used in such transmissions. Most advanced, however, are continuously variable transmissions or "CVTs" which have the potential to maintain the engine in full-load continually. CVTs are not new, but they have been dogged in the past by poor control methods, low power densities, and endurance problems. New electronics and materials advances have the promise to solve these difficulties.

Perhaps in no other arena will the technology revolution have a greater impact than with weight reduction, for a host of new materials have come forward with the desirable structural characteristics for use in a light vehicle. These range from ceramics to composite and polymer plastics to aluminum and magnesium alloys. The impact of these materials on weight reduction is substantial. One hundred lbs. of steel replaced by the appropriate amount (to yield the same degree of strength) of aluminum yields a 55 lb. reduction, replaced by a composite plastic a 65 lb. reduction, and replaced by magnesium a 75 lb. reduction.[5]

Of all the "new" materials, plastics has perhaps been the most widely publicized. Three automotive manufacturers--General Motors, Honda, and Renault--have already produced vehicles with body panels almost entirely composed of composite plastics. And work is proceeding furiously on developing chassis composed of plastics. Work is also progressing in applying other materials to light vehicles. Nissan has already commercialized turbocharger blades composed of ceramics; not only is the weight of the resulting turbocharger substantially reduced, but its performance characteristics are noticeably improved. Audi is working cooperatively with Alcoa Aluminum to produce an aluminum body for its sedan that will achieve at least a ten percent overall weight reduction. And Volvo Car Company has developed a prototype vehicle in which magnesium accounts for an unheard-of seven percent of the vehicle's weight as compared with less than one percent for most of today's commercial vehicles.

Aerodynamics is another arena that has seen tremendous improvements in recent years. In the late 1970s, the average drag coefficient of American cars was about .48, with European vehicles achieving a slightly better .44.[6] In contrast, today the best drag efficient achieved by a production vehicle is .28.[7]

And experimental vehicles are doing better still; Ford Motor Company has developed an experimental vehicle, the Probe V, with a drag coefficient of .137, besting that of an F-15 military jet aircraft.[8]

Improvements in tires are also being pursued vigorously. New tiremaking techniques developed by Goodyear and Bridgestone are delivering better rolling resistance while also improving steering precision, riding comfort, and braking performance. In addition, new materials for tires are being investigated, exemplified best by a small tire company in Kittsee, Austria, Polyair Maschinenbau GmbH, which has developed a tire made of liquid-injection-molded polyurethane. Tests conducted by the Venezuelan government have determined that cars with such tires use almost 10 percent less fuel.[9]

Light vehicle accessories are not being ignored either by the technology revolution. Energy demand by guzzling air conditioners is being reduced with better electronic control, the use of variable displacement compressors, and window glazings that decrease the amount of insolation into a vehicle. In addition, high efficiency alternators, electric power steering to replace energy-guzzling hydraulic versions, and low wattage "electroluminescent" interior lighting are being energetically sought. Finally, efforts are being launched to substitute solar energy for the engine as the source of power for accessories.

Perhaps the greatest challenge in improving the energy efficiency of light vehicles lies in reducing the energy loss associated with braking. Volkswagen was one of the first companies to address this issue by seeking to tap the unused engine energy associated with deceleration and idling. Its prototype Glider Automatic uses the engine to charge a flywheel storage device; in decelerating or idling conditions, when sufficient energy is stored within the flywheel, the engine is then turned off and the flywheel used to power the necessary accessories and restart the engine when power is next required.

A more advanced concept than this approach was under development for years at the University of Wisconsin, with support from a Toyota-based company. In this case, energy is stored whenever demand is less than what can be delivered at full-load conditions. Not only is this stored energy used instead of the engine in deceleration or idling, but it supplements the engine's power when additional boost is required. Finally, during braking a large fraction of the kinetic energy of the wheels is recaptured and stored. Under some circumstances, this approach is believed to be able to improve the fuel economy of some light vehicles as much as 100 percent.[10]

The examples just listed are only a fraction of the research activity now ongoing. These are being pursued for reasons that extend well beyond their fuel economy benefits, for they offer a multiplicity of benefits. Plastics, for example, are attractive not only because they are lightweight, but because they can reduce assembly costs, and have a longer lifetime than their corrosion-prone steel counterparts. Similarly, CVTs are attractive to many not only because they are more fuel efficient, but because they offer a "jerk-free" ride compared to conventional automatic transmissions.

Inevitably, the question arises as to when these advanced technologies could reach commercialization. As already noted, some--such as plastic body panels--are already on production vehicles, albeit in limited numbers. Others, however, will require several more years of development. In truth, the rate at which these technologies will be introduced will depend heavily upon the aggressiveness of their research and development. Should an aggressive stance be taken, most of these technologies could probably be introduced into commercialization by the end of this century, with a few entering production in the early years of the twenty-first century (see Table 1).

But will these technologies really work in on-the-road vehicles? And what types of efficiency improvements could they produce in real vehicles? In the past, these questions have been difficult to answer until the technologies were commercially available. However, answers have become noticeably easier to come by lately because of the plethora of fuel efficient "prototype" vehicles that have been brought forward in recent years. As shown in Table 2, these prototypes have been introduced principally by European light vehicle manufacturers, often at the instigation of their individual governments.

Generally speaking, these prototypes combine low aerodynamic drag with improved engine and transmission designs and innovative substitution of lightweight materials. As a result, with few exceptions, the vehicles enjoy city fuel economies in excess of 60 miles per gallons (mpg) and highway economies in excess of 75 mpg.

Moreover, even these innovative prototypes do not incorporate the most advanced fuel economy technologies now under development. For example, not one makes use of a ceramic engine. Similarly, no such vehicle utilizes advanced energy storage and regenerative braking systems. Hence, the fuel economy potential for light vehicles by the end of the century is probably even higher than reflected by these prototypes.

Not only has the development of fuel efficient vehicles been useful in demonstrating what efficiency technologies can produce, but it has also illustrated that other consumer amenities need not be sacrificed to achieve high efficiency levels. Perhaps the best example of this can be seen in the prototype developed by Volvo, the LCP 2000.

Volvo's engineers began their prototype project by setting minimum criteria for the LCP 2000 to ensure that it was safe, non-polluting, comfortable, affordable, performed well, and could be manufactured easily. As a result, the vehicle--which has a fuel economy of 63 mpg city/81 mpg highway--can accelerate from 0 to 60 miles per hour in 11 seconds (the average for the 1986 American fleet was 13.1 seconds), and comfortably seat four to five persons. In addition, it was designed to have a greater crashworthiness than is required today in the U.S. of production automobiles--American safety requirements being the toughest in the world--and to have emissions levels close to American requirements--these again being the most stringent worldwide. Finally, the car was engineered such that the increased costs of its materials and associated technologies could be offset by a streamlined assembly process, a side-benefit of the use of these materials. Hence, the LCP 2000's engineers estimate this vehicle could be manufactured at a cost comparable to today's cars of equivalent size.

EFFECTS ON COMPETITIVENESS

The technical feasibility of improving light vehicle fuel economy is therefore quite clear. Moreover, it is also clear that research is occurring worldwide in the pursuit of these new technologies. Unfortunately, however, most of that research is occurring overseas, not here at home, as can be seen in Table 3. And to the degree that research on certain technologies is occurring in this country it tends to be in the earliest stages compared with competitors in Europe and especially in Japan.

In short, domestic automakers are just not convinced there is a long term interest, either on the part of their buyers or on the part of the U.S. government, in improving the fuel economy of their fleets. Hence, the strategy they have assumed has reflected this conviction. As the U.S. market has become increasingly competitive in recent years, with more and more manufacturers offering vehicles for sale here, domestic automakers have responded by ceding their small car lines to their competition. Rather than manufacturing small cars, they are increasingly becoming distributors of small cars manufactured by others.

The rationale for such a strategy makes sense right now: consumers are showing little interest at present in fuel economy. Furthermore, U.S. manufacturers have never been particularly good at producing small cars that are attractive to consumers and that they can make money on. Instead, their expertise has been in the larger car category, where they can draw a greater profit.

Of course, as the previous discussion has alluded to, fuel economy need not be delivered only in a small car. The technologies under development can boost the efficiency of larger cars as well. But, with American manufacturers lagging their competition in fuel economy research, they are unlikely at this point to be able to bring forth an efficient larger car either.

What does this mean for the long term health of the domestic automotive industry? As long as the status quo continues, the domestic industry's strategy makes sense. But should there be a rapid increase in demand for fuel economy, the industry could find itself even more vulnerable than it was during the 1970s, the last time demand materialized rapidly for fuel economy. At that time, because consumers could not find the fuel efficient cars they wanted in American manufacturer showrooms, they turned to imports instead; as a result, domestic automakers found themselves in a free fall in terms of maintaining their market share. In 1975, imports accounted for 18 percent of all sales and Japanese imports only 9 percent. But by 1980, these figures had jumped to 27 and 21 percent respectively.[11]

Should demand for fuel economy arise again in the future, domestic automakers could suffer even more than they did in the past. At least during the 1970s, they had some small car capacity so they could respond to demand for fuel economy by increasing their production of small cars. Now, however, they are closing down that small car capacity; hence, should consumers shift their tastes back to efficiency, U.S. manufacturers would be at the mercy of their small car suppliers to be able to meet the enhanced demand. It certainly would not be surprising if those suppliers chose to meet the enhanced demand directly rather than providing the vehicles to their American distributors.

Furthermore, during the 1970s laws were on the books that pushed automakers to improve the fuel economy of their new vehicles. As respected a trade publication as Automotive News noted recently in an editorial that without those laws the domestic industry would have been in worse shape than it turned out to be during the last oil crisis . But those laws have become outdated now; there is no longer any legislative or executive push on American automakers to improve the efficiency of their new cars and light trucks.

The conclusion to be reached is clear: in the event of a rapid increase in demand for fuel economy, the domestic automotive industry could find itself in worse shape than in the past in being able to respond to that demand. It will lack both the research base and the small car manufacturing base to respond.

But, is a renewed demand for fuel economy likely to occur? The answer is yes, for two reasons: the rising peril of another oil crisis and increased concern about global warming. With respect to the threat of a future oil crisis, it is important to note that after several years of stable oil use in this country, oil consumption has begun to grow again. Leading the way has been the transportation sector, which accounts for two-thirds of the oil consumed in this country. As a result, the import share of oil used in this country has been climbing. It was 41 percent in 1988, up from 32 percent just three years before.[12] Many expect the situation to get far worse in the future, with the import share of petroleum consumption exceeding 50 percent in the next few years, and import levels potentially reaching 11 or 12 million barrels a day by the end of the century, compared with the previous high of 9 million barrels a day prior to the last oil crisis.

Not only does increased oil use for transportation increase the threat of a new oil crisis, but it also contributes substantially to the increased hazard of global warming. In 1985, highway transportation accounted for one-quarter of the greenhouse gas, carbon dioxide, produced by fossil fuels in the U.S.[13] Concern is so great about the adverse impact of global warming that discussions are now ensuing to propose reductions in greenhouse gas emissions. Such a reduction could only occur in the transportation sector if the efficiency of transportation vehicles is improved.

POLICIES REQUIRED

The preceding discussion has led to several conclusions. First, the technical feasibility exists to improve the efficiency of light vehicles well beyond what is being achieved in today's production vehicles. And second, there are very good reasons for seeking to tap this technical potential and increase the fuel efficiency of cars and light trucks sold in this country. These include a renewed peril of another oil crisis, an increased threat to enhance global warming, and a rising danger to the competitiveness of the American automotive industry.

But, as in the past, government actions are required to prompt the fuel economy changes needed. The so-called free market cannot be relied upon to have the long range vision to bring about these changes without the involvement of the government. Fortunately, since 1975 we have had experience with government policies to promote fuel economy, so we are not starting from the beginning in determining what will work and what will not. And that experience has demonstrated that the first step in promoting fuel economy has to be establishing fuel economy standards for all light vehicles sold in the U.S.

Fuel economy standards were first legislated in 1975 as Corporate Average Fuel Economy (CAFE) standards and they have singularly proven to be the most successful conservation policy ever enacted in this country. Indeed, the conservation they produced accounted for fully 20 percent of the total oil savings achieved by the industrialized country members of the International Energy Agency between 1979 and 1983.[14]

In setting the levels of fuel economy to be achieved in new standards, it is important to strike a balance between setting levels aggressive enough to sufficiently ameliorate the problems they are being enacted to address while simultaneously selecting levels that do not place too much of a burden on the automotive industry. Setting levels too low risks establishing a policy that will not solve the problems it is designed to solve, be they reducing the risks of a new oil crisis, enhancing the competitiveness of domestic automakers, or decreasing the rate of increase of global warming. On the other hand, setting levels too high risks diverting the automotive industry from other pursuits that will be required to keep it competitive, for example, investing in new manufacturing technology.

Standards have been proposed for ten years from now that range from 34 mpg to as high as 60 mpg. Unfortunately, enacting standards with ten year goals at either end of this spectrum is unlikely to be a wise policy. A standard of 34 mpg is not very aggressive considering that the average new car fleet economy now is 28 mpg. As such, it will do little insofar as reducing transportation energy use enough to lessen the risk of a new oil crisis or decrease carbon dioxide emissions. Furthermore, it will do little to enhance the competitiveness of the U.S. industry. After all, many of the Japanese automotive companies already have fleet fuel economies close to 34 mpg. Hence, should a standard of this level be enacted, the Americans could well find themselves in a situation where they have to work to meet the standard while their competitors glide by.

On the other hand, a standard approaching 60 mpg, while technologically "do-able", could place considerable burden on the domestic automotive industry, an industry that will be facing increasingly larger, more able, and more technically sophisticated competitors in the years ahead. The industry will clearly need to be competitive in the fuel economy of the vehicles it produces, but it will also have to be competitive as well in manufacturing technology, in styling, and in new model development. And a very aggressive fuel economy standard could force the domestic industry to pull resources away from these other pursuits, thereby threatening its competitiveness.

Rejecting the extremes just discussed, a fuel economy standard that seeks to establish in ten years a new car fleet average of 45 mpg and a new light truck fleet average of 35 mpg appears to be the wisest course of action. It is sufficiently aggressive to make a dent in holding down carbon dioxide emissions and oil use while not unduly burdening the automotive industry.

In setting standards with these levels of fuel economy, it is important to structure them to be as constructive as possible. Although the CAFE standards enacted in 1975 were extremely effective, they did have some unanticipated problems that should be corrected in the next round of standard setting. First, by setting a universal standard that applied equally to all manufacturers regardless of the mix of sizes of the cars they produced, the CAFE standard unfairly favored manufacturers of smaller car lines. Hence, Japanese manufacturers generally benefitted at the expense of American automakers. American automakers, after all, produce a wide mix of vehicles from small to large, while Japanese manufacturers have tended to dominate in the smaller car lines. As a result, it was easier for the Japanese to meet a given standard than the Americans.

Several suggestions have been made for how to correct this problem. One has been that rather than set fleetwide average standards, standards be set for each size class, that is for subcompacts, compacts, and so on. However, such an approach is quite onerous to enforce. Moreover, it removes much of the flexibility given to manufacturers with the CAFE approach, where they could chose which car lines they wished to target for fuel economy improvements so long as a final CAFE target was achieved. In addition, a size-class standard could prove more expensive to automakers since it would force them to upgrade all of their car lines simultaneously rather than be able to concentrate on one or two size classes at a time, as they were able to do with the CAFE approach.

A better option might be to place a uniform percentage improvement requirement on the average fleet fuel economy of each manufacturer, calculated in such a way that the 45 mpg goal still is achieved. This approach maintains the flexibility the manufacturers enjoyed with the CAFE option, but requires all manufacturers to work equally hard at improving the fuel economies of their fleet. A percentage improvement requirement of 60 percent would apply equally to an American manufacturer with a fleet average of 27 mpg as to a Japanese manufacturer with a fleet average of 34 mpg.

Another change that is needed is to space the milestones by which the manufacturers are measured on their fleet fuel economy to be less frequently than every year, as was done with the past CAFE law. Fleets do not change very rapidly in their average fuel economy from one year to the next; significant changes in fuel economy only occur when new models are introduced, which may be as infrequently as every three to five years with some automakers. Hence, setting the fuel economy milestones to be every three to four years rather than every year makes more sense.

A third needed change in fuel economy standards pertains to light trucks. Future regulations for light trucks, the authority for which now rests with the Secretary of Transportation, should instead be set into law, as is now done with cars. In the past, the Department of Transportation has been all too easily influenced by the industry to weaken the standards it proposes. Light trucks are an ever growing portion of light vehicle sales, accounting for a third of such sales today compared with less than 20 percent in 1976.[15] Since these trucks are less efficient than cars and their lifetimes are longer, they account for a disproportionate share--fifty percent--of the oil consumed over the lifetime of light vehicles.[16]

Last, reforms are required in the regulatory framework of a future fuel economy standard. Ambiguities in the structure of the 1975 CAFE law opened the door for considerable abuse of the intent of the law. Rollbacks in fuel economy requirements for a given model year were granted almost on the eve of that model year. Requests were even made for retroactive rollbacks. And after a while, the excuse that consumers do not want fuel economy proved to be sufficient reason to roll back standards. All of these developments undermined the seriousness with which the fuel economy standards law was regarded by the industry.

Before closing, I wish to add that while the thrust of these hearings is on automotive fuel economy regulations, it is important to note that fuel economy standards by themselves will not cause fuel economy improvements to occur. Automotive companies need a research base to be able to bring forward the fuel efficient technologies expected with new standards. There must be a market for the fuel efficient cars the standards will require. And that market cannot exist without good, unbiased, and plentiful information on fuel economy.

The government presently has a $50 million transportation conservation research program, but it focuses on very long term technologies that will not be commercializeable, if ever, until the next century. Almost no research is being done on shorter term technologies, either with government support or with the support of the automotive companies. Something needs to be done about this problem.

Fuel prices are still quite low, thereby giving consumers the wrong message about the importance of fuel economy. Something needs to be done about this problem.

Consumers are receiving little discouragement from purchasing "gas guzzlers". A tax on gas guzzlers exists, but loopholes in the law have enabled domestic automakers from escape from having the tax assessed on the models that should be assessed. Furthermore, the threshold level below which the tax is assessed, which used to rise annually, no longer rises.

Something needs to be done about this problem.

Consumers also receive little incentive to purchase "gas sippers", be they within a size class or across all car lines. President Carter proposed a gas sipper rebate to address this gap, but it was never enacted. Something needs to be done about this problem.

And finally, the quality of information that consumers receive on fuel economy is flawed. The test used to determine a vehicle's fuel economy is outdated. Access to information on the fuel economies of new cars is limited. Something also needs to be done about this problem.

CONCLUSION

There is no doubt it is technically feasible to improve the efficiency of new light vehicles. And there is no doubt there is ample reason to pursue such a strategy. The threat of a new oil crisis is rising, as are concerns about global warming. And the domestic automotive industry must be able to improve the efficiency of its vehicles in order to stay competitive. The onus now lies on the federal government to devise an effective fuel economy policy to answer these problems.

ENDNOTES

1. Cole, D.E., and Johnson, J.H., Spark Ignition and Diesel Engines as Applied to Passenger Cars and Light Trucks, working paper prepared for the U.S. Congressional Office of Technology Assessment, December 4, 1979.

2. Kamo, Takashi, et. al., "Lean Mixture Sensor", Society of Automotive Engineers paper #850380, 1985.

3. Isuzu is working on a first generation ceramic engine, which it claims will improve fuel economy 30 percent (Automotive News, October 20, 1985). Recent analysis by Energy and Environmental Analysis, Inc. for the Office of Technology Assessment places the potential for fuel economy improvements from a truly adiabatic engine at 60 percent (Developments in the Fuel Economy of Light-Duty Highway Vehicles, June 1988).

4. Rowand, Roger, "The 2-Stroke", Automotive News, July 4, 1988, p.1.

5. Flemings, Merton C., et.al., Materials Substitution and Development for the Light Weight, Energy Efficient Automobile, prepared for the U.S. Congressional Office of Technology Assessment, February 8, 1980.

6. Buchheim, R., et.al., "Contribution of Aerodynamics to Fuel Economy Improvements in Future Passenger Cars", Proceedings of the First International Automotive Fuel Economy Research Conference, 1979, U.S. Department of Transportation, 1979.

7. This drag coefficient characterizes the Renault 25.

8. Probe V News Conference, October 28, 1985, Tokyo, Japan.

9. Marshall, Stuart, "First Test Report on the Revolutionary Plastic Tire", Popular Science, April 1983.

10. Rohde, Steve M., and Schilke, Neil A., "The Fuel Economy Potential of Heat Engine/Flywheel Hybrid Automobiles", 1980 10.Flywheel Technology Symposium Supplement, October 1980.

11. Motor Vehicle Manufacturers Association, MVMA Motor Vehicle Facts and Figures '88, 1988.

12. Woutat, Donald, "The Oil Crisis Scenario", Los Angeles Times, December 25, 1988.

13. DeLuchi, M.A., et. al., Transportation Fuels and the Green House Effect, Universitywide Energy Research Group, UER-182, December 1987.

14. Testimony by Dr. Robert H. Williams, Center for Energy and Environmental Studies, Princeton University, at the Hearing on Automobile and Light Truck Fuel Economy of the Subcommittee on Energy Conservation and Power of the U.S. House of Representatives, July 31, 1984.

15. Department of Energy, Periodic Energy Report, Number 2, December 1987.

16. Ibid.

Table 1

ESTIMATED DATES OF PRODUCTION-READINESS FOR ADVANCED LIGHT VEHICLE FUEL EFFICIENT TECHNOLOGIES

1990 1995 2000

[ENGINES]

Variable Turbocharger

Torch Ignition

Solid Lubricants

Pressure Wave Supercharger

1st Generation Ceramic Diesel

Advanced Ceramic Diesel

Advanced Variable Engine Displacement

Oxygen Separating Engine

Variable Valve Engine

Dual Circuit Cooling

Electronically Controlled Cooling

Peak Pressure Ignition Sensor

"Clean" Stratified Charge

Electronically Controlled IDI Diesel

"Clean" DI Diesel

"Clean" Ultra Lean Burn

[TRANSMISSIONS]

1st Generation All-Gear Lock-Up Clutch

2nd Generation All-Gear Lock-Up Clutch

Electronically Controlled Automatic Transmission With Torque Converter

Electronically Controlled Automatic Transmission With Synchromesh Clutches

Lubricated Belt CVT With Hydraulic Control

Electronically Controlled "Dry" Belt CVT

Beltless CVT

Table 1 (cont.)

ESTIMATED DATES OF PRODUCTION-READINESS
FOR ADVANCED LIGHT VEHICLE FUEL EFFICIENT TECHNOLOGIES

1990 1995 2000

[MATERIALS]

Composite Body Panels

Polymer Body Panels

Composite Load-Bearing Parts

Composite Chassis

Fiber-Reinforced Plastic Engine Parts

Increased HSLA Steel Use

Aluminum Load-Bearing Parts

Aluminum Body

Fiber-Reinforced Aluminum Engine Parts

Magnesium "Interior" Parts

Magnesium Engine, Load-Bearing Parts, And Wheels

Ceramic Liners And Turbocharger Blades

[AERODYNAMICS]

Drag Coefficients In The Middle ".20s"

Drag Coefficients In The Low ".20s"

[TIRES]

New "Dynamic" Tire-Making Processes

"Plastic" Tires

[ACCESSORIES]

Variable Displacement Air Conditioner

Solar Power For Accessories

Advanced Electronically Controlled Air Conditioner

Laminated Reflecting Film Auto Glass

"Smart" Alternator

High Efficiency Alternator

Variable Power Steering

Electric Power Steering

Electroluminescent Lighting

[STOP-START/ENERGY STORAGE]

Engine Stop-Start With Flywheel Storage

Complete Energy Storage

Table 2

HIGH FUEL ECONOMY PROTOTYPE VEHICLES

Company	General Motors	British Leyland	Volkswagen	Volkswagen	Volvo	Renault	Renault	Peugeot	Peugeot	Ford	Toyota
Model	TPC (gasoline)	ECV-3 (gasoline)	Auto 2000 (diesel)	VW-E80 (diesel)	LCP 2000 (diesel)	EVE+ (diesel)	VESTA2 (gasoline)	VERA+ (diesel)	ECO 2000 (gasoline)	—— (diesel)	AXV (diesel)
Number of passengers	2	4-5	4-5	4	2-4	4-5	2-4	4-5	4	4-5	4-5
Aerodynamic Drag Coefficient	.31	.24-.25	.25	.35	.25-.28	.225	.186	.22	.21	.40	.26
Curb Weight (lb)	1040	1460	1716	1540	1555	1880	1047	1740	990	1875	1430-target
Maximum Power (hp)	38	72	53	51	52,88	50	27	50	28	40	56
Fuel Economy (mpg)*	61 city 74 hwy	41 city 52 hwy	63 city 71 hwy	74 city 99 hwy	63 city 81 hwy	63 city 81 hwy	78 city 107 hwy	55 city 87 hwy	70 city 77 city	57 city 92 hwy	89 city 110 hwy
Innovative Features	Aluminum body and engine.	High use of aluminum and plastics.	DI with plastic and aluminum parts, flywheel stop-start.	Modified DI 3-cyl. Polo, flywheel stop-start, supercharger.	Hi magnesium use; 2 DI engines developed, 1 heat insulated.	Supercharged DI with stop-start.	High use of light material.	DI engine, high use of light material.	2-cylinder engine, high use of light material.	DI engine.	Weight is 15% plastic, 6% aluminum, has CVT & DI engine.
Development Status	Prototype complete, no production plans.	Prototype complete.	Prototype complete.	Ongoing research, possibility of production.	Prototype complete, adaptable to production.	Prototype complete.	Program completed.	Ongoing development.	Ongoing development.	Research.	Ongoing development.

Table 3

ADVANCED FUEL ECONOMY INNOVATION BEING UNDERTAKEN BY AUTOMOTIVE COMPANIES

Component	Technology	Region Where Developed	Company/ies Involved	Development Status
Engines	Variable Turbocharger	Japan	Nissan	In production.
		Europe	VW	Prototype testing.
		U.S.	GM, Ford	Research.
	Variable Displacement	Japan	Mitsubishi	In production.
			Toyota, Mazda	In prototype.
		Europe	Porsche	Research.
		U.S.	GM	At one time in production.
			Ford	Research.
	Peak Pressure Sensor	U.S.	GM	Research.
	Variable Valves	Japan	Mitsubishi	In production.
			Honda	Research.
	Dual Cooling Circuits	Japan	Toyota	Research.
		Europe	VW	Research.
			Porsche	Research.
		U.S.	Ford	Research.
	Electronic Cooling Control	Japan	Nissan	Production set for 1987.
	Ultra-Lean-Burn	Japan	Toyota	In production.
			Honda	Moderate lean-burn in production
			Mitsubishi, Mazda	Research.
		U.S.	GM, Ford	Research.
	Electronically Controlled Diesel	Japan	Isuzu	In limited production.
	Direct Injection Diesel	Japan	Isuzu	In production.
			Toyota	In high efficiency prototype vehicle.
		Europe	Ford	In production.
			British Leyland	Pre-production.
			Renault, VW, Peugeot, Volvo	In high efficiency prototype vehicles.
			Fiat, Opel	Research engine testing.
		U.S.	Ford, GM	Research engine testing.

Table 3 (cont.)

ADVANCED FUEL ECONOMY INNOVATION BEING
UNDERTAKEN BY AUTOMOTIVE COMPANIES

Component	Technology	Region Where Developed	Company/ies Involved	Development Status
	Adiabatic/ Ceramic Diesel	Japan	Isuzu	Ceramic diesel production set for 1990.
			Toyota, Nissan, Mitsubishi,	Research, manufacturing ceramic parts.
			Mazda	Ceramic combustion chamber being developed.
		Europe	VW, Opel	Research.
		U.S.	Ford, GM	Research.
	Stratified Charge	U.S.	Ford, GM	Research, development on hold.
Transmissions	Advanced Discrete Transmissions	Japan	Isuzu	NAVI5 in production.
			Toyota, Mitsubishi	Electronic transmission in production.
			Honda	Hypershift in production.
		Europe	VW	Automatic 4-to-5 speed shift production-ready.
			Renault	Automatic 4-to-5 speed and automatic 5-speed in prototype.
		U.S.	GM	Advanced all-gear lock-up clutch and 6-speed manual under development.
	Continuously Variable Transmissions	Japan	Subaru	In production Justy.
		Europe	Ford, Fiat	Production imminent.
			Volvo	Research.
		U.S.	Ford	Research on electronic 2nd generation CVTs.
			GM	Research.
Advanced Materials	Plastic body panels	Japan	Honda	In production.
			Toyota	In prototype, parts in production.
		Europe	Renault	In production.
			British Leyland, Volvo, Fiat, VW	In prototypes.
		U.S.	GM	In production.
			Ford, Chrysler	Parts in production.

Table 3 (cont.)

ADVANCED FUEL ECONOMY INNOVATION BEING UNDERTAKEN BY AUTOMOTIVE COMPANIES

Component	Technology	Region Where Developed	Company/ies Involved	Development Status
	Plastic structural parts	Japan	Toyota	Parts in prototype.
			Honda	Research.
		Europe	VW	Rear axle in prototype, conrods and passenger safety compartment research.
			Volvo	Composite pedals and floor in prototype.
		U.S.	GM	Leaf springs in production, research on composite chassis, and engine parts.
			Ford	Driveshaft in production, prototype composite chassis.
			Chrysler	Research on composite chassis.
	Aluminum	Japan	Honda	Fiber-reinforced conrods in production.
			Toyota	High use in prototypes including fiber-reinforced conrods and pistons.
			Mazda	Hood production imminent.
		Europe	Audi	Aluminum body production set for 1995.
			British Leyland, Volvo	High use in prototypes.
		U.S.	Ford	Driveshaft in production.
	Magnesium	Japan	Toyota	Wheels in prototype.
			Honda	Research on pulleys.
		Europe	Volvo	Very high use in prototype including engine block, load-bearing parts, wheels.
		U.S.	Chrysler	Housings in production.
			Ford	Housings in production.

Table 3 (cont.)

ADVANCED FUEL ECONOMY INNOVATION BEING
UNDERTAKEN BY AUTOMOTIVE COMPANIES

Component	Technology	Region Where Developed	Company/ies Involved	Development Status
	Ceramics	Japan	Nissan	Turbocharger blades in production.
			Toyota	Exhaust pipe lining in prototype.
Advanced Aerodynamics	Drag coefficient below .3	Japan	Subaru	.29 in production.
			Toyota	In prototype.
		Europe	Renault	.28 in production.
			British Leyland, Peugeot, VW, Volvo	In prototypes.
		U.S.	Ford	.137, record low, in prototype.
			GM	In prototype.
Air Conditioning	Variable Displacement	Japan	Toyota	2-stage version in production.
		U.S.	GM	Infinite version in production.
	Thermal ray reflecting glass	Japan	Nissan	In production.
	Advanced electronic controls	Japan	Subaru	In production.
			Toyota	Under development.
	Solar cell-powered ventilation	Europe	Saab	In prototype.
	Solar cell-power	Japan	Toyota, others	Research.
Alternator	"Smart" alternator	Japan	Honda	In production.
Power Steering	Variable-assist power steering	Japan	Toyota, Honda, others	In production.
		Europe	VW, others	In production.
		U.S.	Chrysler	Slated for Liberty.
	Electric power steering	Japan	Toyota, others	Research.
		U.S.	Ford, GM	Research.
Stop-Start/ Energy Storage	Stop-start with flywheel	Japan	Nissan	Prototype testing.
		Europe	VW	Production-ready.
	Flywheel storage with regenerative braking	Japan	Toyota	Related company supporting research.

Senator **Bryan**. Thank you very much, Ms. Bleviss.

Mr. Ledbetter.

STATEMENT OF MARC R. LEDBETTER, SENIOR ASSOCIATE, AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY

Mr. **Ledbetter**. Thank you.

I am going to be referring to a number of attachments to the back of my testimony, so it would help you understand what I am saying if you quickly turn to those attachments. These attachments make a number of points that I think are important to this debate, the first of which is that improving automobile performance in the United States is having a detrimental effect on auto fuel economy.

We hear the argument that we have hit the wall, that there is not much more that we can do technologically other than pushing people into small cars. But clearly the record shows that performance is still improving and there is all kinds of evidence in automotive literature to show that improved performance has a detrimental effect on fuel economy.

Average engine power per cubic inch of displacement has gone up 50 percent since 1975. That is an enormous improvement in engine power. That is per cubic inch.

As you can see in attachment A, the average horsepower for all classes of engines, eight cylinder, six cylinder, and four cylinder engines, continues to rise through 1980–1988, excuse me.

Also, you will see in the bottom graph on attachment A that the average acceleration time to go from zero to 60 has also declined sharply since 1982. Now, those improvements in acceleration time since 1980 in our estimation have resulted in at least a six percent reduction in fuel economy since 1982.

But that six percent number does not reflect the additional fuel economy achievements that could have been had had the power improvements that I referred to earlier been used to reduce engine displacement. So that six percent is a bottom end estimate.

If you flip over to attachment B, you will see a chart that has been produced by the EPA. This addresses the question that has come before the committee on the previous panelists of how significant are automobiles in addressing the greenhouse effect.

This is a table from the recent EPA study, where they list a number of policy measures for reducing future global warming. And fourth—or excuse me, third on that list is improved automobile fuel economy. That bar represents the assumption that we can improve U.S. fuel economy to 40 miles per gallon by the year 2000 and then get the world's fuel economy up to the range of 50 miles per gallon by the year 2025.

As you can see, the reduction in global warming due to those improvements outweigh the reductions from a near-complete phaseout of CFC's. It is larger than the reductions that could be due from solar technologies by the year 2050.

So clearly this is one of the major important areas for addressing global warming.

Attachment C addresses another important point that has come before this committee, and that point is that a number of economists argue that past fuel economy improvements were not due to the CAFE regulations, that it was largely due to price.

This is a very simple graph, but it argues very persuasively that a lot more was going on to drive fuel economy levels up than just price. You can see after 1981 there has been a steady drop in the real price of gasoline. Yet the CAFE levels of new automobiles continue to rise after that.

There is obviously something else going on. I would argue it is regulation.

Senator **Gore**. Did you neglect to cite the source of this brilliant work?

Mr. **Ledbetter**. It is on there.

Senator **Gore**. Oak Ridge National Laboratory.

Mr. **Ledbetter**. Please now refer to attachment D. This addresses the question of what we might be able to get out of, say, increased gasoline taxes or a carbon fee. Some of the previous panelists have argued that we do not need CAFE standards, that all we need is an increased gasoline tax or perhaps a small carbon fee, and we could achieve a lot.

This graph shows the average cost per mile of operating a vehicle. You can see that the largest fraction of that cost is the capital cost of the car, and then moving on up the graph you can see that the fuel costs are quite small. And if you move horizontally along the graph, you can see that the fuel costs become smaller, much smaller, as fuel economy goes up. That should not be any surprise.

But the important point that can be drawn from this graph is that, even if you were to substantially increase the price of gasoline, the curve, the fuel curve on the top there, would remain relatively flat, so the car buyer will not see a significant reduction in per mile costs for driving that automobile.

It is just a consequence of a car consuming a fairly small amount of fuel when you get into high fuel economy ranges. You can see that there is a bit of a slope to the curve around 30 fuel economy, but it pretty much levels off after that level.

There is other evidence that shows that higher fuel prices are not going to push us into substantially more fuel efficient cars. Japan's fuel economy is about 30 miles per gallon, West Germany's is about 31, United Kingdom is about 31. All of those countries have substantially higher gasoline prices than ours, from two to three times higher.

Now, even though the consumer will not see a great advantage in improved fuel economy from moving to higher fuel economy levels, it is still clear that it is cost effective for consumers to move to higher fuel economy levels. If you use the data that is being used by the Department of Energy in their recent analysis on what fuel economy technologies cost us, you can calculate that the average cost per gallon of gasoline saved is 50 cents per gallon.

So clearly there is a good deal for consumers to be had in improving fuel economy.

Does the yellow light mean I have one minute left?

Senator **Bryan**. Go ahead, Mr. Ledbetter.

Mr. **Ledbetter**. All right. Please refer to attachment E. Now, this graph shows the improvement in fuel economy in the bottom end of the fleet. The line representing low MPG cars is a collection of all the car models whose fuel economy in 1980 was below 20 miles per gallon.

I plotted the average fuel economy over the years, and you can see when plotted against the increasing gas guzzler tax that they move in lockstep with the gas guzzler tax as it is raised.

Incidentally, at the same time you can see during the same period the real price of gasoline was plummeting.

If you turn over to attachment F, which faces that graph, you can see what was going on in the remainder of the fleet for the fleet that does not include those MPG cars. After 1983, their fuel economy was virtually flat. All the fuel economy improvement was coming out of the bottom end of the fleet. Obviously, the gas guzzler tax is playing a very strong role.

I point this out because I think that this committee should not overlook the potential in the gas guzzler tax and that Congress ought to consider a comprehensive approach to addressing fuel economy through CAFE standards, through increased gas guzzler taxes.

And by the way, we do support increased gasoline taxes to help achieve those goals. It is not going to get us into the 35 or 40 MPG range which is technologically possible, but it will support these efforts.

One last point that I need to make, all right, and that is the issue of small cars that has been brought up. If you look at attachment G, you can see an analysis that was done on the cause of fuel economy improvements since 1977, and the cross-hatched bars represent the improvement due to technological change, the solid bars represent the improvement due to changes among size classes, moving to smaller cars.

You can see only a small percentage of the improvement in fuel economy can be described by a shift toward smaller cars.

And then, as I think has been pointed out to you before by previous witnesses, in attachment H you can see the average interior volume of cars has remained virtually constant since 1978. The conclusion therefore is that smaller cars—excuse me—higher fuel economy does not necessarily mean smaller cars.

[The statement follows:]

STATEMENT OF MARC LEDBETTER, AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY

Good morning Mr. Chairman. My name is Marc Ledbetter. I am a Senior Associate with the American Council for an Energy-Efficient Economy.[*]

Since 1976 the fuel economy of passenger cars has improved from 17 mpg to 28 mpg, and the fuel economy of light trucks has improved from 17 to 21 mpg (EPA ratings). Had this improvement not occurred, cars and light trucks in the United States would now be consuming an additional 2.5 million barrels of oil per day and drivers would be spending at least an additional $40 billion per year for gasoline purchases. Moreover, higher oil demand over the years would have exerted upward pressure on world oil prices, which could have markedly slowed the international economic recovery since the early 1980s.

The improvement in light vehicle fuel economy since the early 1970s has been nothing short of spectacular. The economic and national security benefits of this improvement are immeasurable, and in the long run, the environmental benefits of this improvement, in the form of reduced carbon dioxide (CO_2) emissions, reduced oil spills, and less drilling in environmentally sensitive areas, will also be very substantial.

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[*] The American Council for an Energy-Efficient Economy is a non-profit organization dedicated to the advancement of energy-conserving technologies and programs. The organization gathers, evaluates and disseminates information useful to the Congress, government agencies, utilities, businesses, and consumers.

Unfortunately, the long trend toward steadily improving light vehicle fuel economy has almost come to a halt. Low gasoline prices, a series of rollbacks of fuel economy standards, and a cessation in the rise of gas guzzler taxes has taken the pressure off automobile manufacturers to improve fuel economy. This country's recent remarkable progress in reducing foreign oil imports is being rapidly undone. U.S. dependence on oil imports has shot up from 27% of total oil consumed in 1985 to 37% in 1988. These imports cost the United States about $30 billion in 1988, and projections by the Department of Energy show our oil import bill rising to about $100 billion by 2000 given a continuation of current trends. Moreover, our oil import dependence is expected to exceed 50% by the early 1990s.[1]

Increasing Automobile Performance is Reducing Fuel Economy

Engineering improvements have led to a remarkable 50% improvement in the average horsepower per unit of engine displacement in new cars since 1975.[2] Since 1982, a large part of this technological advancement has been used to make cars more powerful and faster, instead of improving fuel economy. Average engine horsepower has gone up steadily since 1982 and average acceleration time (the time it takes to go from 0 to 60 miles per hour) has decreased sharply for four, six, and eight cylinder engines. (See Attachment A.)

Other things held equal, a reduction in acceleration time causes a decline in fuel economy. A recent analysis estimates that fuel economy is roughly proportional to the square root of acceleration time.[3] Thus the decline in average acceleration time of passenger cars since 1982 has caused about a 6% decline in average fuel economy. However, this estimate does not account for the substantial fuel economy improvement that could have been achieved by using engine power improvements to decrease engine displacement while holding acceleration constant.[4]

Technological improvements that could be used to improve fuel economy are therefore being used to make vehicles ever more powerful and faster, instead of being used to reduce fuel consumption. It is indeed ironic that an industry bent on building faster cars uses automobile safety as an argument against improved fuel economy.[5]

Fuel Economy and Global Warming

In addition to worsening our balance of trade and harming our national security, the sharp slowdown in fuel economy improvements will result in much higher future emissions of CO_2, and thereby contribute to global warming. Past improvements in light vehicle fuel economy have already had a significant effect on U.S. carbon dioxide emissions. Had the improvement in light vehicle fuel economy between 1976 and 1988 not occurred, carbon emissions from light vehicles would be 107 million metric tons higher (about 7% of total U.S. carbon emissions).

Representatives from Ford and General Motors minimized the role of light vehicles in global warming in the recent hearing on fuel economy before the Senate Subcommittee on Energy Regulation and Conservation, arguing that there are so many sources of greenhouse gasses that the light vehicle industry should not be singled out for policies to reduce CO_2 emissions. However, light vehicles are the single largest end user of fossil fuels in the United States, which makes them the largest source of carbon emissions. They emit about 200 million metric tons of carbon per year, more than total carbon emissions from fossil fuels in all of Africa. Improving the energy efficiency of light vehicles will thus have a significant effect on future CO_2 emissions.

The effect of future fuel economy improvements on global warming will of course depend on the degree of those improvements. EPA's recent draft report to Congress on "Policy Options for Stabilizing Global Climate," estimates the effect on global warming of substantial fuel economy increases in the U.S. and world automobile fleet. EPA estimates that increasing the world's fleet fuel economy to 50 mpg by the year 2025 would reduce projected global warming by 5% in a future scenario that assumes rapid technological change and economic growth. For perspective, EPA estimates that the 5% reduction is larger than the reduction in global warming that could be achieved through a near complete phaseout of CFCs by 2003, or through a rapid development of low-cost solar technology. (See **Attachment** B.)

Improving U.S. light vehicle fuel economy is not the complete solution to the global warming problem, but among the many important efforts we must undertake to slow the rate of global warming, it is one of the most important and feasible.

Market Forces and Improved Automobile Fuel Economy

Rising gasoline prices obviously played a very important role in improving fuel economy over the last fifteen years. Some economists have suggested that the entire improvement in light vehicle fuel economy since the early 1970s was due to market forces.

A simple graph showing an historical plot of real gasoline prices and passenger car fuel economy improvements demonstrates the fallacy of this argument. (See **Attachment C.**) The graph shows that fuel economy continued to rise during a long period of falling real gasoline prices. The only way to reasonably explain this sustained increase in fuel economy is the existence of CAFE standards and gas guzzler taxes.

Although gasoline prices will continue to be an important influence on future fuel economy levels, there is strong reason to believe that higher gasoline prices will not drive average fuel economy levels substantially higher than their current levels. At fuel economy levels above about 30 mpg, the fraction of total automobile operating costs attributable to fuel consumption is small, and the small decreases in fuel costs caused by even higher levels of fuel economy are partly offset by increases in the capital costs of improving fuel economy. (See **Attachment D.**) This phenomena is true even with fuel prices that are double or triple their current level.

Perhaps the best evidence that higher fuel prices won't push passenger car fuel economy into the high 30s or 40s mpg is that other industrialized countries with gasoline prices that are two to four times higher than U.S. prices have new car fuel economies in the high 20s and low 30s. The International Energy Agency reports 1985 new car fuel economy of 31.4 mpg for West Germany (1988 gasoline price, \$2.23/gallon), 31.1 mpg for the United Kingdom (\$2.63/gallon), and 30.2 mpg for Japan (\$3.58/gallon).[6]

Further Fuel Economy Improvements are Cost-Effective

It is very difficult to obtain reliable data on the cost of fuel economy improvements. Automobile manufacturers consider this data proprietary, and therefore closely guard it. However, the Department of Energy has gained access to some fairly reliable information to estimate the cost of increasing the use of existing fuel economy technologies. Using this data on fuel economy technologies and their costs, the average cost of improving fuel economy to 34.8 mpg is $.50 per gallon saved.[7] (This calculation assumes a 10% discount rate, and 10 years of fuel savings.)

This cost is based on rapid incorporation of new fuel economy technologies into the automobile industry. 1995 is less than six years away. With more time to incorporate fuel economy technologies, higher levels of fuel economy should be achievable for similar or even lower costs.

Federal Policies are Needed to Improve Light Vehicle Fuel Economy

The best and most reliable way to substantially increase light vehicle fuel economy is to enact a complementary set of policies that work in unison to improve fuel economy.

First and most important, higher fuel economy standards should be enacted. Passenger car standards should be raised to 45 mpg and light truck standards should be raised to 35 mpg by the year 2000. Several studies, including ones by the Solar Energy Research Institute, the Office of Technology Assessment, and by Dr. Frank von Hippel of Princeton University concluded these levels of fuel economy are economically and technologically feasible.[8] Raising fuel economy standards to this level would, in the year 2000, reduce oil consumption by 1.1 million barrels per day, save consumers (net of fuel economy improvement costs) $13 billion per year, and reduce carbon emissions by 45 million metric tons. (Oil and consumer savings, and carbon emission reductions will grow substantially after this date as the 45 mpg vehicles comprise a larger share of the total vehicle fleet.)

New fuel economy standards need not have the same structure as the existing CAFE standards. A change in the law that would require each manufacturer to increase its fleet fuel economy by the same percentage above a base year would be an acceptable approach. Such an approach would address the complaint by domestic manufacturers that the CAFE standards put full-line manufacturers, such as General Motors, at a disadvantage to makers of smaller cars. Each manufacturer, regardless of the fuel economy of their current fleet, would face the same burden for improving fuel economy. Several Senate automobile fuel economy bills recommend this approach.

A very modest passenger car fuel economy standard of 34 mpg by 2000 was recently proposed by Senator Metzenbaum in the Energy Committee. Senator Metzenbaum's proposal was based on a projection by the Energy Information Administration that the market alone would increase new car fuel economy to 34 mpg, and on a Department of Energy analysis that concluded an average 35 mpg was technologically and economically feasible by 1995 for new passenger cars.

Senator Metzenbaum's proposal is far too modest. The DOE study concluded that 35 mpg was feasible within 6 years, not eleven. DOE's study is based on existing, commercialized technology, which is a reasonable assumption for projecting fuel economy potential for only six years from now. Given eleven years, the automobile industry should certainly be able to commercialize and improve many new fuel economy technologies, just as they did when Congress established a standard in 1975 for the industry to meet in 1985.

Second, a higher gasoline tax should be enacted to help push the market in the direction of higher fuel economy. As indicated earlier, a gasoline tax, even a relatively large one, will not by itself by able to push fuel economy into the 40 mpg range. But it will help create the consumer demand for fuel efficiency that will support manufacturer's efforts to improve fuel economy.

Third, and very important, Congress should increase the fuel economy threshold for the gas guzzler tax. At present, only cars that fall below 22.5 mpg are subject to the tax. Whatever level future fuel economy standards are set at, the gas guzzler tax threshold should be increased by the same percentage, so that a strong mechanism exists for pushing up the bottom end of the fleet. Even if fuel economy standards are not raised, an increase in the gas guzzler tax threshold could still be an effective policy tool for raising fuel economy.

The gas guzzler tax has long been overlooked as an effective policy tool for improving fuel economy. However, there is strong evidence that the gas guzzler tax played an important role in improving fuel economy, especially between 1983 and 1986.

Attachment E shows a plot of the average fuel economy of cars whose average fuel economy was below 20 mpg in 1980, the year before the gas guzzler tax took effect. Also plotted on the graph are the gas guzzler tax threshold and the real price of gasoline for the years 1980 through 1987. As can be seen, the fuel economy of low-mpg cars rose after the guzzler tax threshold was raised high enough to pose a tax threat. Manufacturers clearly decided it was more economic to improve fuel economy than to even pay a small gas guzzler tax. This improvement in fuel economy occurred during a period of sustained decreases in the price of gasoline. As can be seen in **Attachment F** this improvement in low-mpg cars occurred when the fuel economy of the remainder of the new car fleet hardly improved, suggesting that the gas guzzler tax played a major role in post-1983 fuel economy improvements.

Gas guzzler taxes have a number of desirable features. Since the tax only applies to new cars, low-income persons will be virtually unaffected by the tax. And since the tax is a large penalty imposed at the point of automobile purchase, instead of very small sums stretched out over many years, it will likely have a very strong effect on the willingness of cars buyers to seek higher mileage cars. Revenues from the tax could also be used to provide rebates to buyers of highly efficient cars.

Other Issues

The Growing Use of Light Trucks

A very important issue that should not be overlooked is the growing number of light trucks in the U.S. light vehicle fleet. In 1970 they only represented 15% of new light vehicle sales. They now represent about one third of new light vehicle sales, and their popularity is projected to increase even more. The large majority of light trucks are being used as passenger cars. A 1982 survey by the Department of Commerce found that 73% of light trucks do not carry freight.[9] (As defined by Commerce, freight doesn't even include craftsman's tools.)

On average, new light trucks achieve 21 mpg (EPA), 26% below the 1988 new car average of 28.5 mpg. Given their relatively low fuel economy, and their increasing popularity, Congress would be overlooking a large opportunity for fuel savings if it does not include light trucks in policy measures to improve fuel economy. We also recommend that a gas guzzler tax be established for light trucks, and like passenger cars, the guzzler tax threshold should be increased by the same percentage as the light truck fuel economy standard.

Actual vs. EPA-rated MPG

EPA's fuel economy testing procedure substantially overestimate's actual fuel economy. Actual fuel economy is currently estimated to be 15-20% lower than the EPA rating.[10] The fuel economy labels on new cars are adjusted to reflect this shortfall, but for CAFE compliance purposes, the unadjusted EPA rating is used. Analysts project that because of growing urban congestion, higher highway speeds, and a larger ratio of urban to highway miles, on road fuel economy could fall 25-30% below EPA ratings by the year 2000.[11]

Unless the EPA fuel economy testing procedure is changed to more accurately reflect on road driving conditions, fuel economy improvements required by higher fuel economy standards will produce substantially less fuel savings than initially projected.

Higher Fuel Economy Does Not Mean Smaller Cars

One of the assertions often heard in the automobile fuel economy debate is that higher fuel economy means forcing people into small cars. In the recent hearing before the Subcommittee on Energy Regulation and Conservation, representatives of Ford and General Motors used the term "small car" as a synonym for fuel-efficient car.

This is a myth. The record on fuel economy improvements in the last decade shows that technological improvements were overwhelmingly responsible for the fuel economy improvements since 1977. **Attachment G** shows the results of an analysis of the cause of recent automobile fuel economy improvements. As can be seen, increased market share for smaller cars only explains a small percentage of the overall fuel economy improvement since 1977. Average automobile interior space has also remained almost constant since 1978. (See **Attachment H.**)

In addition, the recent Department of Energy analysis on the potential for fuel economy improvements concluded that fuel economy could be raised in just six years to 38 mpg, with no shift toward smaller vehicles.[12]

Conclusion

Federal fuel economy policies made a major contribution toward the fuel economy improvements achieved since 1975. But because they require no further improvements, and because gasoline prices have fallen nearly 50% since 1980, the long upward trend in fuel economy has stalled. This cessation in fuel economy improvement puts our nation's economy and security at risk. Furthermore, because large energy efficiency improvements in all sectors or our economy will be necessary to slow projected climate changes that threaten life on this planet, and because light vehicles are the single largest end user of fossil fuels, we must begin again the task of improving vehicle fuel economy. The market will be of great assistance in pushing fuel economy levels higher, but it will not be sufficient. Congress must respond by passing laws to push fuel economy to much higher levels.

REFERENCES AND NOTES

1. Energy Information Administration, Annual Energy Outlook 1989, U.S. Department of Energy, January, 1989.
2. Heavenrich, Robert M., Murrell, J. Dillard, "Light-Duty Automotive Technology and Fuel Economy Trends Through 1988," June 1988, EPA Technical Report, EPA/AA/CTAB-88-07.
3. Ross, Marc, "Energy and Transportation in the United States," Annual Review of Energy, Vol. 14, 1989, forthcoming.
4. There is a close association between fuel consumption and engine displacement.

5. Testimony submitted by both Ford and General Motors to the Subcommittee on Energy Regulation and Conservation on April 4, 1989 cited concern for automobile safety as a reason not to raise fuel economy standards.

6. International Energy Agency, Energy Conservation in IEA Countries, 1987, Organization for Economic Cooperation and Development, Paris, 1987.

7. The cost of conserved gasoline reported here differs from the cost of conserved gasoline reported in a paper written by Difiglio and his colleagues. (Difiglio, Carmen, Duleep, K.G., and Greene, David L., "Cost Effectiveness of Future Fuel Economy Improvements," submitted to The Energy Journal, January, 1989.) The average cost of conserved gasoline is calculated here, whereas the Difiglio paper reports the marginal cost of conserved gasoline, the cost of the last gallon of fuel saved.

8. Solar Energy Research Institute, A New Prosperity, Building a Sustainable Energy Future, Brick House Publishing, Andover, MA, 1981; Office of Technology Assessment, Increased Automobile Fuel Efficiency and Synthetic Fuels, U.S. Government Printing Office, Washington, D.C. 1982; and Gray, C. and von Hippel, F., "The Fuel Economy of Light Vehicles," Scientific American, May 1981; Ross, M., op cit.

9. Bureau of the Census, Truck Inventory and Use Survey, 1982, Census of Transportation, U.S. Department of Commerce.

10. Personal communication from Carl Hellman, EPA Ann Arbor, MI, to Marc Ross, University of Michigan.

11. Personal communication from Phil Patterson, U.S. Department of Transportation, Washington, D.C.

12. Difiglio, C., et, al, op cit.

ATTACHMENT A

Average Engine Horsepower
Passenger Cars

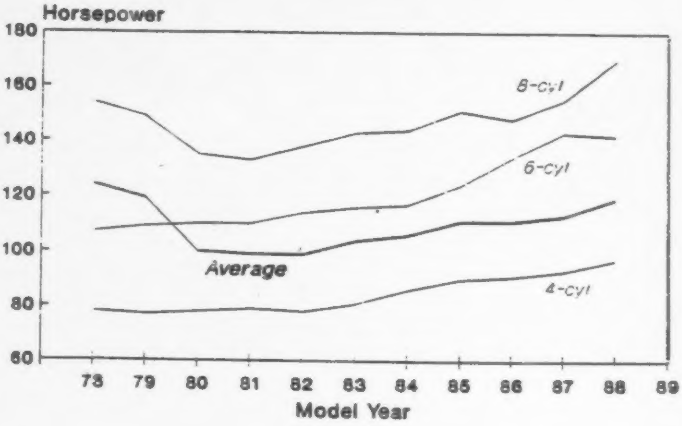


Fig. 9

Average Zero to 60 Acceleration
Passenger Cars

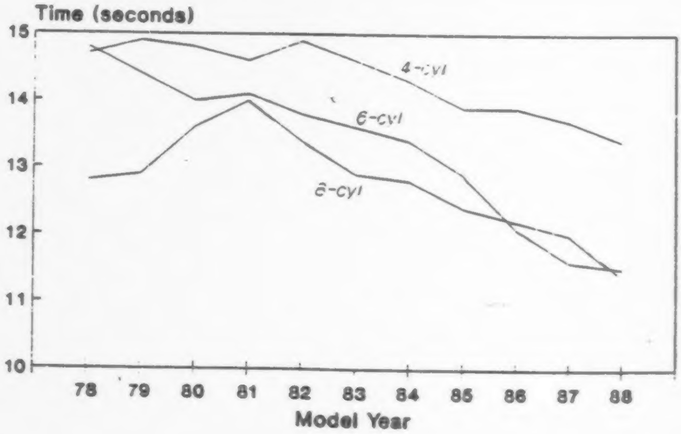


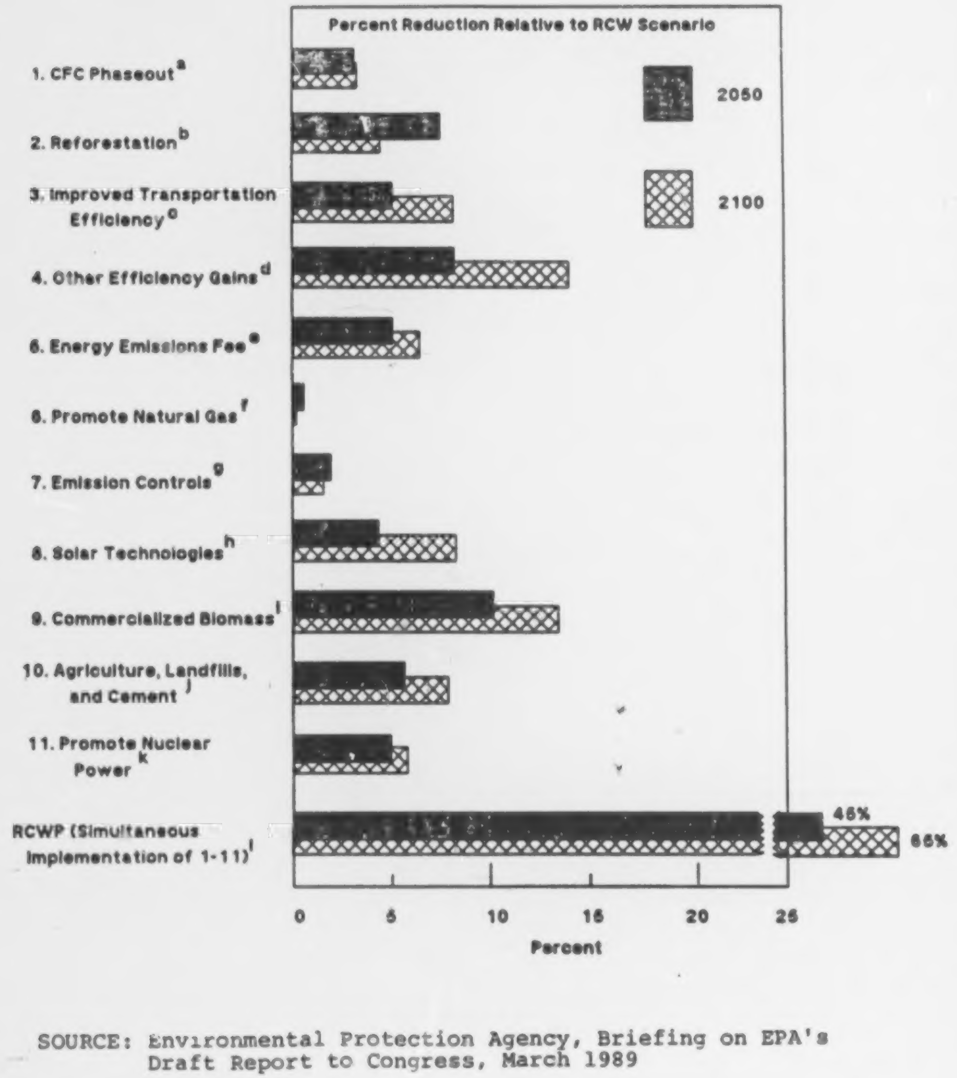
Fig. 10

SOURCE: Reference #~~1~~ 2

ATTACHMENT B

Many Individual Measures, Each Having A Modest Impact on Greenhouse Gas Emissions, Can Have a Dramatic Impact on the Rate of Climatic Change When Combined

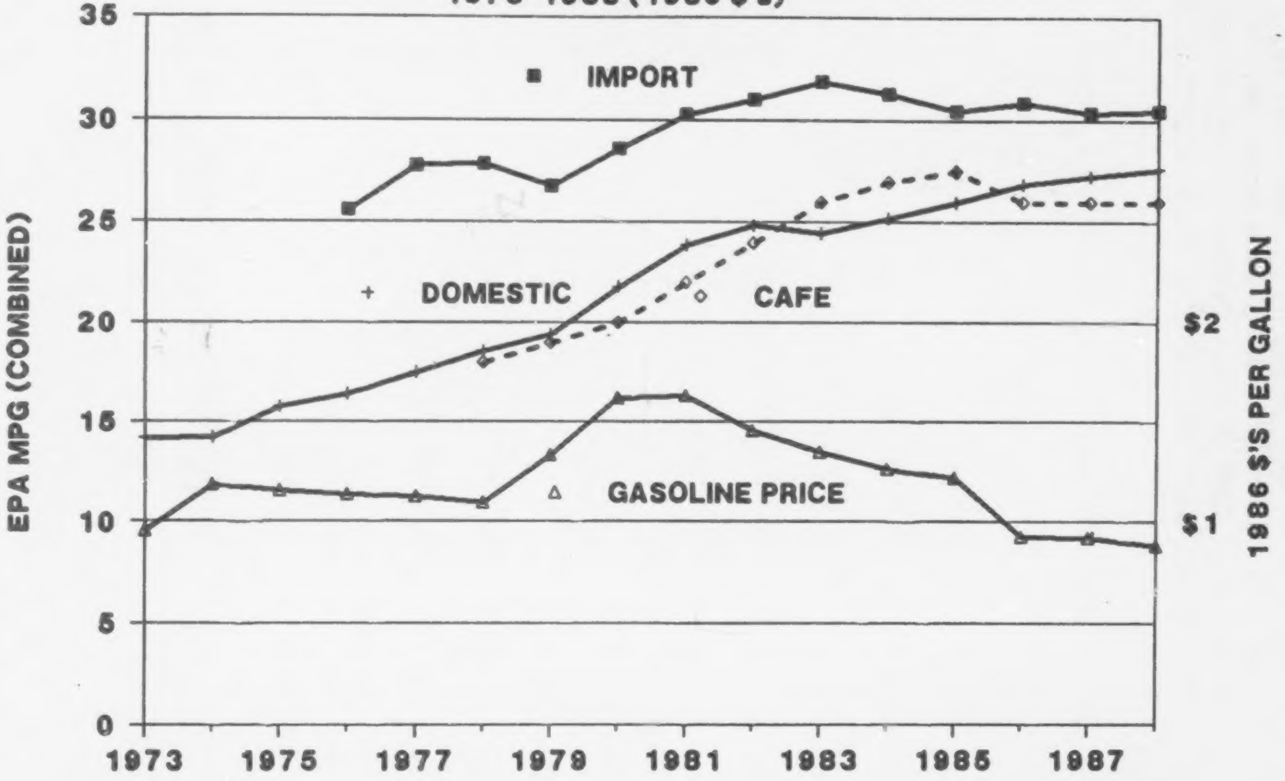
Relative Effectiveness of Different Policy Strategies



SOURCE: Environmental Protection Agency, Briefing on EPA's Draft Report to Congress, March 1989

ATTACHMENT C

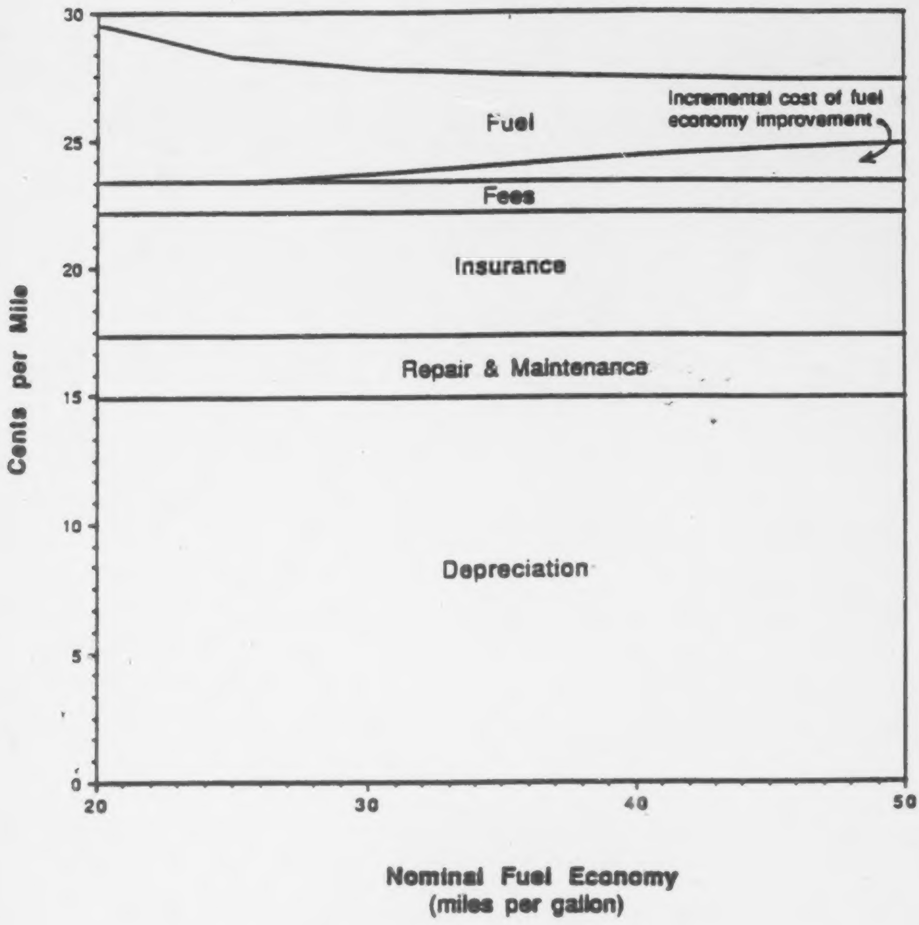
TRENDS IN FUEL PRICE AND AUTO MPG
1973-1988 (1986 $'s)



Source: David Greene, Oak Ridge National Laboratory

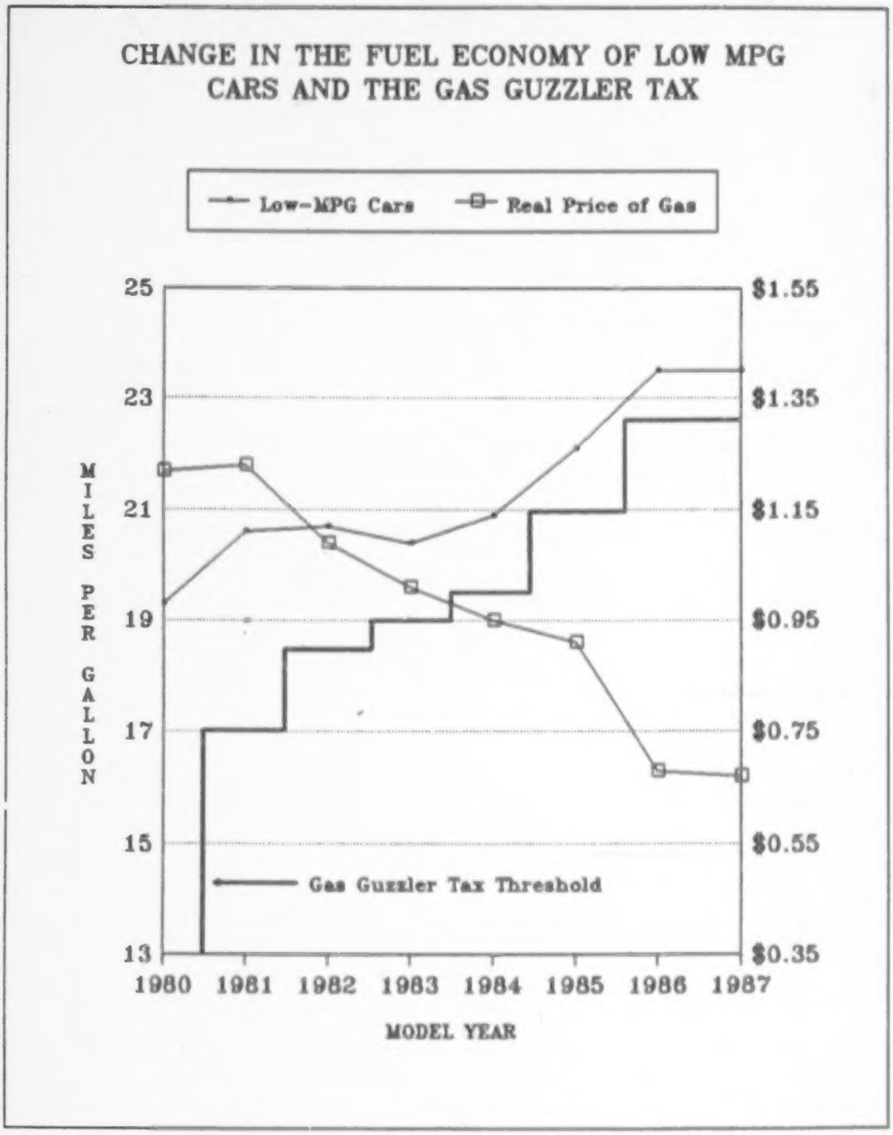
ATTACHMENT D

The Cost of Owning and Operating a Midsize Car vs. Fuel Economy (1988 Prices)



SOURCE: Reference #~~2~~ 3

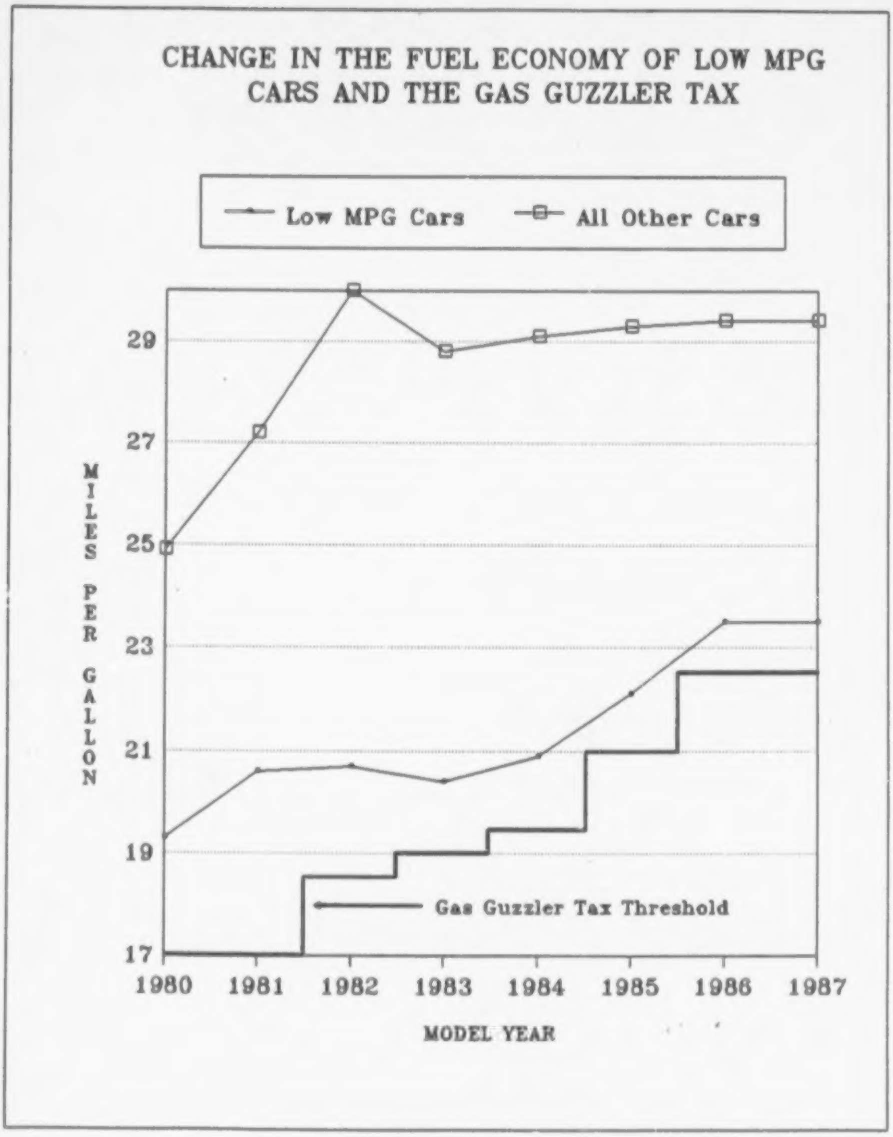
ATTACHMENT E



CHANGE IN THE FUEL ECONOMY OF LOW MPG CARS AND THE GAS GUZZLER TAX

AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY

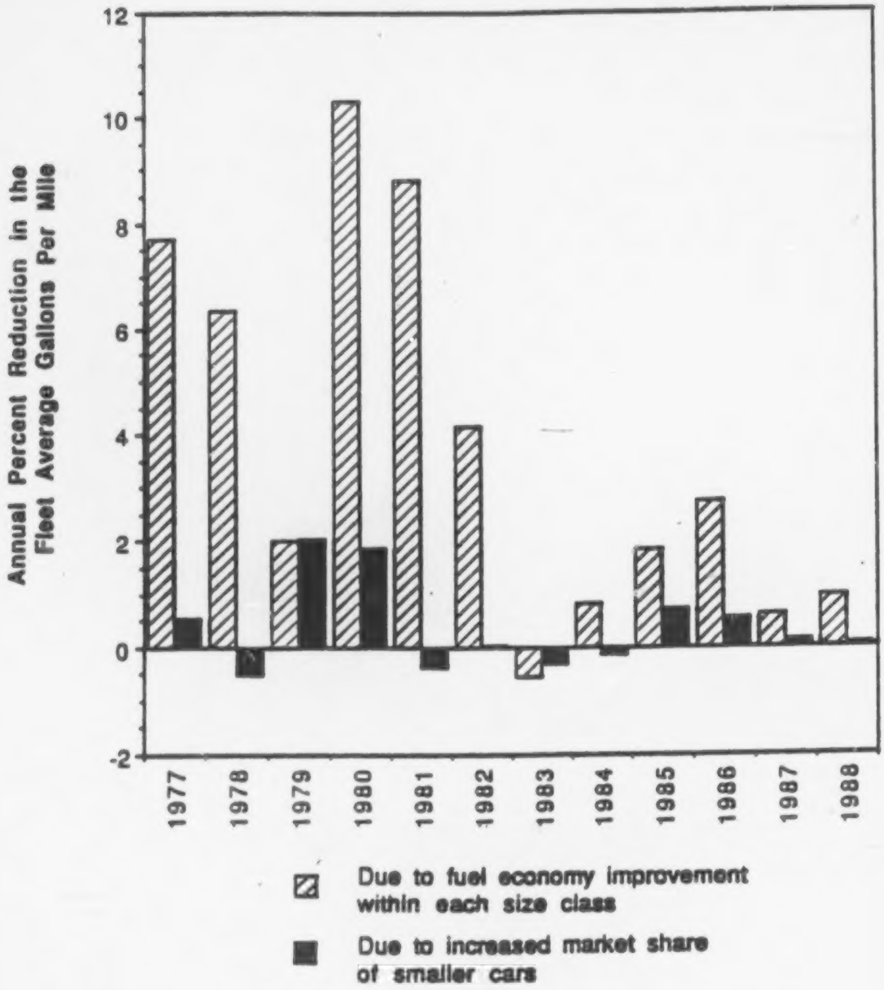
ATTACHMENT F



CHANGE IN THE FUEL ECONOMY OF LOW MPG CARS AND THE GAS GUZZLER TAX

AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY

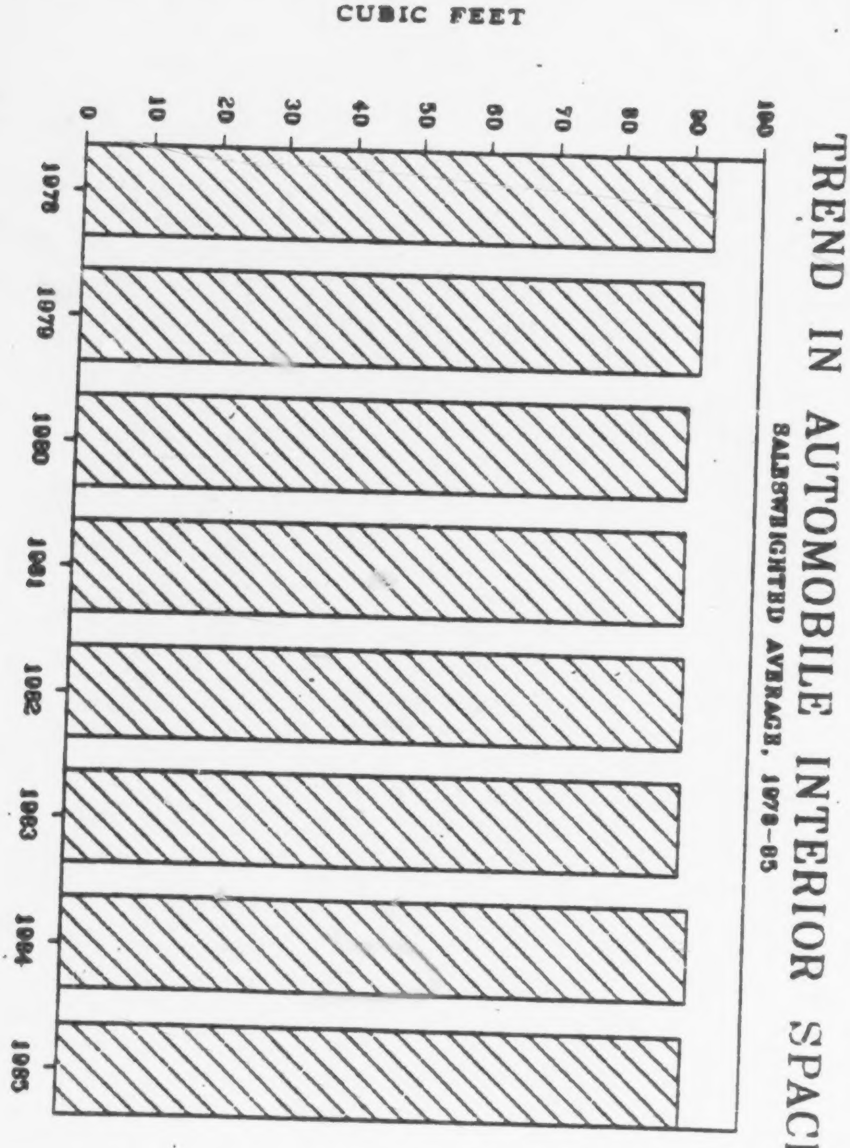
ATTACHMENT G



Divisia Decomposition of Fuel Economy Changes in New Automobiles, 1976-1988

SOURCE: Reference #~~2~~3

ATTACHMENT H



SOURCE: Dr. David Green, Transportation Efficiency and Alternative Fuels: The Road to the Future, Oak Ridge National Laboratory

Senator Bryan. Thank you very much, Mr. Ledbetter.

Mr. Ditlow.

STATEMENT OF CLARENCE DITLOW, EXECUTIVE DIRECTOR, CENTER FOR AUTO SAFETY

Mr. Ditlow. Thank you, Senator Bryan.

Mandatory fuel economy standards are a great success which should be strengthened. Despite recent CAFE relaxations, the 1989 vehicle fleet uses 2.5 million barrels per day less gasoline than if it had the same fuel economy as in 1975. And but for DOT's relaxation on CAFE standards, the nation would be saving 600,000 more barrels per day of gasoline in 1990.

Ford and GM allege that they will lose sales and jobs if CAFE standards are strengthened. If anything, relaxation of CAFE standards allows auto companies to export small car production and U.S. jobs abroad.

In 1984, GM and Ford sold fewer than 1500 imported vehicles. In order to meet stringent standards, GM and Ford had to produce as many small cars as possible domestically. But with relaxation of CAFE standards to 26, Ford and GM pursued a new strategy of making small cars abroad because they were no longer needed for CAFE compliance. And we find by 1988 Ford and GM were importing more than 500,000 cars, at an expense of 175,000 U.S. jobs and nearly a mile per gallon in CAFE.

When EPCA was enacted in 1975 with CAFE levels of 25 fuel economy for 1980 and 27.5 fuel economy for 1985, the auto industry said it could not be done. The position of the industry then matches the position of the industry now. Ford told this committee: "This proposal will require a Ford product line consisting of all sub-Pinto-sized vehicles." Chrysler projected that:

> This bill would outlaw a number of models and engine sizes, including most full-sized sedans and station wagons. It would restrict the industry to producing subcompact size cars or even smaller ones.

Congress had the courage to stand fast in the face of such dire predictions. In words that could have been a prophecy rather than a reflection, Senator Inouye opened the hearings in 1974 by stating:

> Perhaps without exception, each time a regulatory requirement on the automobile has been suggested the automobile industry has said it cannot be done, only to find that when the time comes it was done.

Obviously, the credibility of the auto industry is a major issue at these hearings.

To the examples Senator Inouye listed of regulations that the car companies said could not be met, but were met, must now be added one more—the 1980 to 1985 CAFE standards. And we met the standards while keeping large cars on the road. No freedom was lost. Instead, the freedom to be secure from foreign energy threats was advanced.

The 1975 CAFE standards offer another lesson beyond how to judge the credibility of the auto industry. When Congress required a 50 percent improvement in CAFE to 20 miles per gallon by 1980 and 27.5 or 100 percent by 1985, Congress set standards similar to what is before Congress today. The 20 miles per gallon standard simply required the car companies to use known technology, just as does the 34 miles per gallon standard under consideration today.

Congress knew that 27.5 miles per gallon would be difficult to reach by 1985, but set the standard based on the need of the nation to conserve energy. By doubling CAFE, the 1985 standard forced technology, just as would a 45 to 55 miles per gallon CAFE standard for the year 2000 and beyond.

The 34 miles per gallon level is an intermediate goal. It can and should be achieved within four years, just as 20 miles per gallon was achieved within four years.

A redoubling of CAFE levels by 2000 and beyond will be difficult, as was the initial doubling by 1985. But the need of the nation to conserve energy and reduce carbon dioxide emissions is even more important now than then and deserves no less resolve on the part of the Congress.

Thank you.

[The statement follows:]

STATEMENT OF CLARENCE M. DITLOW III
DIRECTOR, CENTER FOR AUTO SAFETY
Before the
CONSUMER SUBCOMMITTEE
SENATE COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION
Washington, D.C. May 2, 1989

Mr. Chairman and members of the Committee, thank you for the invitation to testify on automotive fuel economy and the need to increase CAFE standards. The Center for Auto Safety is a non-profit organization that works primarily on consumer issues pertaining to motor vehicles including fuel economy, safety, emissions and fuel quality. The Center has played a leading role in the development of strong CAFE standards under the Energy Policy and Conservation Act of 1975 (EPCA).

The motor vehicle fuel economy standards mandated by Congress in the Energy Policy and Conservation Act (EPCA) represent the most significant energy conservation program in this country. The express purpose of the fuel economy program was to reduce U.S. vulnerability to foreign events by improving vehicle fuel efficiency over 1974 levels by 50% by 1980, and 100% -- to 27.5 MPG -- by 1985.

The Congressionally mandated fuel economy standards are a spectacular success that should be sharply strengthened rather than weakened as has happened over the past five years. Despite recent CAFE relaxations, the 1989 vehicle fleet will consume 2.5 million barrels per day (MMB/D) less gasoline than what it would have if the fleet had the same fuel economy as in 1975.

On a broader level, the CAFE standards have advanced major national policies. These include enhanced national security through reduced dependence on imported oil; significantly reduced fuel consumption; improved U.S. balance of trade and balance of payments resulting from reduced oil imports; reduced inflationary pressure; lessened dependence of the U.S. economy on foreign petroleum supplies; stimulation of substantial innovation in automotive design and production technology; and helped alleviate the greenhouse effect by reducing carbon dioxide (CO_2) emissions. There can be little doubt that the CAFE standards, by decreasing demand for petroleum, have helped break OPEC's ability to fix high oil prices.

Despite the dramatic benefits of the CAFE standards, the Reagan Administration waged regulatory war against stringent CAFE standards and unsuccessfully tried to get Congress to repeal EPCA. These actions include:

- Relaxing the 1986-89 statutory 27.5 MPG CAFE standard for cars;
- Slashing the 1985 and later light-truck CAFE standards;
- Relaxing CAFE test procedures to illegally raise CAFE levels;
- Failing to stringently enforce gas guzzler regulations;
- Decimating DOT's fuel economy program staff so that it can no set and enforce fuel economy standards;
- Reducing the information required from the auto industry which was used to set standards and ensure compliance; and
- Terminating the rulemaking to raise CAFE standards higher than 27.5 MPG for 1986 and later model years.

Under the previous administration, DOT did a complete about face on post-1985 CAFE standards, going from supporting more stringent gas mileage standards beyond 1985 to weakening the 27.5 MPG standard. In January 1981 DOT proposed to raise passenger car CAFE to 41.7 MPG by 1990 and 47.8 by 1995. In an accompanying study entitled *Analysis of Post-1985 Fuel Economy*, DOT concluded that "we must turn to federal new car energy conservation requirements for the post-1985 period . . . to mitigate continuing dependency on foreign oil." But as a result of DOT's failure to issue more stringent CAFE standards beyond 1985 coupled with relaxation of other CAFE standards, the nation will consume an extra 600,000 barrels/day of gasoline in 1990 due to less stringent gas mileage standards. Since it takes almost two barrels of petroleum to produce a barrel of gasoline, the US must import or produce another 1 MMB/D petroleum to offset the CAFE loss. Besides making the nation more dependent on foreign oil, this empty policy increases air pollution and global warming by emitting an additional 80 million tons of CO2 annually. The increased use of gasoline will produce an extra 100,000 tons of reactive hydrocarbons nationally and 1,500 tons per year in cities such as New York and San Francisco.

Need to Conserve Energy by Reducing Gasoline Consumption

DOT itself recognizes that oil imports are higher now than when EPCA was passed with 6.35 MMB/D imported in 1988 versus 5.85 MMB/D in 1975. Petroleum consumption for transportation has gone from 8.98 MMB/D in 1975 to 10.47 MMB/D in 1987. DOT recognizes oil imports could go up to 10.5 MMB/D (56%) by 1995 and 11.7 MMB/D (60%) by 2000. Just on energy supply and demand, there is a greater need now than when EPCA was passed to conserve energy by improved fuel efficiency.

One of DOT's primary points in justifying a CAFE relaxation is that vans and light trucks which are increasingly substituted for passenger cars have poorer fuel economy and efforts to increase car CAFE may shift consumers to these vehicles. To the extent this is a problem, the best alternative is to increase the CAFE standards for light trucks and vans which have lagged three to four years behind cars in applying new fuel efficient technology.

Need to Reduce Gasoline Use and Carbon Dioxide Levels

A major new reason to conserve energy and increase CAFE standards is the "greenhouse effect" -- the build-up of CO_2 levels in the atmosphere from combustion of fossil fuels causing a gradual warming of the earth's temperature. At the June 1988 Toronto Conference on the Changing Atmosphere convened by the United Nations Environmental Program and Canada, 300 scientific delegates from 48 nations agreed that CO_2 emissions must be reduced 20% in industralized countries by 2005 and 50% worldwide by 2050. Since 30% of all CO_2 emissions in the US come from transportation, this goal cannot be attained unless CAFE standards are increased.

Higher CAFE Standards Save US Jobs

DOT alleges Ford and GM will lose sales and jobs if the CAFE standards are strengthed. Close examination of the results of CAFE relaxations to date show there are no economic hardships for Ford and GM. If anything, relaxation of the CAFE standards allow the domestic auto companies to export small car production and US jobs abroad.

In 1985 when the CAFE standard was 27.5 MPG, GM and Ford sold less than 90,000 "captive imports" -- cars made outside the US and

Canada and not counted toward the companies domestic CAFE. In 1984, GM had no imports and Ford had only 1,300. In order to meet the 27.0 and 27.5 MPG CAFE standards for 1984-85, GM and Ford had to produce as many small cars as possible domestically. But with the relaxation of CAFE standards to 26.0 MPG in 1986-88, Ford and GM could pursue a new strategy of making small cars abroad because they were no longer needed for CAFE compliance. Thus by 1988, GM had upped its import sales to 325,000 while Ford had 215,000. For these model years, both Ford and GM could have gained 0.7 MPG in CAFE while creating 175,000 more domestic job if they had made these cars in the US. The table below shows the relation of GM and Ford imports to CAFE standards to date. If CAFE standards are further relaxed or eliminated we project GM and Ford will sell at least one million small cars annually in their import fleet by 1992.

MY	CAFE Standard	Number Imported Cars Ford	GM
1984	27.0	1,300	-0-
1985	27.5*	15,300	74,400
1986	26.0	14,700	309,000
1987	26.0	14,000	315,100
1988	26.0	215,000	325,000

* Ford petition to relax 1985 CAFE filed too late to grant under Act.

Unless CAFE standards are increased, the future looks bleak for the American worker. For 1988, GM included the Pontiac LeMans from Korea, Cadillac Allante from Italy plus the Chevrolet Nova, Sprint and Spectrum from Japan in its import fleet.[1] For 1988, Ford had the Merkur from Germany, Festiva from Korea and Tracer from Mexico. If CAFE standards were abolished as former DOT Secretary Burnley had recommended, the domestic manufacturers would virtually become importers of everything but large cars given the projected worldwide glut of auto production capacity. The existing Chrysler, Ford and GM ownership of foreign plants and investment interests in foreign car producers position them for full-scale production abroad upon elimination of CAFE standards.

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[1] A vehicle such as the Chevrolet Nova which is assembled in the US is counted in the import fleet if its domestic content is less than 75%. Since the engine and transmission for the Nova are made in Japan, its domestic content is less than 75%.

DOT Understimates Manfacturer CAFE

In relaxing the 27.5 MPG CAFE standard the past three years, DOT has set standards lower than what the manufacturers could achieve. As the table below shows, DOT has underestimated Ford and GM's performance from 0.4 to 0.7 MPG in each of these years. This has resulted in a financial windfall of over $500 million to GM and $200 million to Ford in CAFE credits.

	1986	1987	1988
DOT Rule	26.0	26.0	26.0
GM CAFE	26.6	26.7	27.6
Ford CAFE	27.0	26.8	26.4

Since DOT erred in setting the 1986-88 CAFE standards too low, we have an oportunity to judge the Ford and GM allegations that lower gasoline prices and changed consumer demand will not enable them to sell cars at CAFE levels above 26.0 MPG and that they will have to shut down production and lay off workers. Obviously this economic hardship did not occur. Moreover a manufacturer has the option of paying a modest civil penalty as Jaguar, Porsche and Mercedes have done. Mercedes could have met the 26.0 MPG standard by reducing sales of large gasoline models but didn't in order to make a profit on their sales. After all the difference of 1.0 MPG for a manufacturer who fails to meet a standard is simply a penalty of $50 per vehicle. Compared to thousands of dollars in profits on each large vehicle sold, a $50 penalty is clearly the best business decision.

CAFE Can Be Increased By Improved Technology

CAFE can be increased with improved technology and without restricting consumer choice in the market place. The 1981 DOT "Analysis of Post-1985 Fuel Economy" projected a 48 MPG 1985 CAFE based on improvements in technology without restricting large car sales. Some of the better technologies include improved transmissions such as the continuously variable one on the Subaru Justy, multi-valve engines, better materials, and direct injection diesels.

Both performance and fuel economy can be improved with the use of 4-valve per cylinder (4-v/c) engines which can improve fuel economy by 20-25% while decreasing acceleration time. DOE has pointed out that the 1988 Pontiac Grand Am with the 4-v/c Quad 4 engine got 22.4% better fuel economy than the four pound lighter V-6 Chevrolet Beretta while doing 0-60 mph a half-second faster.

Another example of how a 4-valve engine outperforms a 2-valve engine is shown in the comparison (found on the last page) of the 1988 Toyota Camry to the Ford Tempo. The 4-valve Camry is nearly 100 pounds heavier than the Tempo but gets almost 20% better fuel economy and does 0-60 a full 1.6 seconds faster than the Tempo (9.2 to 10.8). Toyota has found this technology so impressive that all its 1988 models were 3 or 4 valves per cylinder.

Safety and CAFE Can Both be Increased

When this Committee was considering the original CAFE legislation in 1974-75, the auto companies said that CAFE standards should not be adopted because auto fatalities and injuries would increase as cars got smaller and lighter to improve fuel economy. Yet the record shows the opposite happened. From 1974 to 1987, average new car CAFE has more than doubled from under 14 to 28.4 MPG. During the same period, traffic fatalities dropped from 3.5 per 100 million vehicle miles traveled to a record low of 2.4. If the death rate had continued at 1974 levels, 21,400 more Americans would have died in traffic accidents last year. We were able to double fuel economy and reduce traffic deaths by 30% because cars and roads became safer.

We can continue to improve fuel economy and reduce traffic fatalities because a wide range of safety measures remain to be put into use just as a wide range of fuel economy technologies remain to be used. We can reduce traffic deaths by another 20,000 annually by incorporating features such as airbags for all front seat occupants, improved side impact protection, upgraded truck standards, and improved vehicle design for pedestrian protection. The safety issue is not whether small cars are less safe than large cars but whether we are going to take advantage of new generations of cars to build safety into them at the same time that we are building fuel efficency into them. Relaxation of CAFE standards over the past three years have resulted in reduced safety as auto companies have taken advantage of the relaxations to increase horsepower and reduce acceleration times to levels not seen since the muscle car days of the 1960's.

DOT's Research Safety Vehicle program in 1977-80 fully demonstrated the feasability of producing safe, fuel-efficient cars. DOT demonstrated with the technology available 10 years ago that a 5-passenger car could be built that would get 43 MPG. According to DOT with the safety improvements built into it, the RSV would have:

> occupant protection in frontal crashes at closing speeds of 80 mph, up to 50 mph in side, and 45 mph in rear impacts [and] significantly reduces impact injury to pedestrians at speeds up to 25 mph.
>
> The level of safety demonstrated by these experimental vehicles is significantly greater than that available in any car on the market today.[2]

Higher CAFE Standards for 1991-2001

The question for CAFE is not whether CAFE should be increased but by how much. An increase to 34 MPG is a modest increase that simply prevents further backsliding by manufacturers from what they project the market will yield. The Center has proposed to DOT that CAFE standards for cars be doubled to 55 MPG by the year 2001 and that comensurate CAFE improvement standards be set for light trucks and vans. These higher CAFE standards are needed to conserve energy, reduce CO_2 emissions, and reduce the export of small car production and American jobs abroad.

Record Shows Auto Industry Wrong About CAFE

When EPCA was enacted in 1975 with statutory CAFE levels of 20 MPG for 1980 and 27.5 MPG for 1985, the auto industry said it could not be done. The position of the auto industry then matches the position of the auto industry now. Ford told this Committee:

> this proposal would require a Ford product line consisting of either all sub-Pinto-sized vehicles or some mix of vehicles ranging from a sub-sub-compact to perhaps a Maverick. This would place definite hardships on the many

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[2] Department of Transportation, "The Safe, Fuel-Efficient Car: A Report on its Producibility and Marketing", 6, 13 (October 1980).

> Americans who legitimately want and need larger cars to meet their personal requirements.[3]

Chrysler predicted even more dire results:

> In effect, this bill would outlaw a number of engine lines and car models, including most full-size sedans and station wagons. It would restrict the industry to producing subcompact-size cars - or even smaller ones . . . .[4]

General Motors echoed Chrysler's predictions:

> This legislation would have the effect of placing restrictions on the availability of 5 and 6 passenger cars--regardless of consumer needs or intended use of vehicle. It is not only an unjustified interference with individual freedom, but an extreme and unusual way for a free society to achieve its goals.[5]

Congress had the courage to stand fast in the face of such dire predictions. In words that could have been a prophecy rather than a reflection, Senator Inouye opened the hearing in 1974 by stating:

> Perhaps without exception, each time a regulatory requirement on the automobile has been suggested, the automobile industry has said it cannot be done only to find out that when the time came, it was done.
>
> Obviously, the credibility of the auto industry is a major issue in these hearings and lies at the heart of whether a voluntary program has any chance of succeeding or whether compulsion is necessary. Given the past record of the automobile industry voluntarism is not a good bet to substantially improve fuel economy.[6]

To the examples Senator Inouye listed of regulations that the car companies said could not be met but were met must now be added one more, the 1980-85 CAFE standards of EPCA. And we met the standards while keeping large cars on the road. No freedom was lost. Instead the freedom to be secure from foreign energy threats was advanced.

The EPCA fuel economy standards of 20 MPG for 1980 and 27.5 for 1985 offer another lesson beyond how to judge the credibility of the auto industry. When Congress required a 50% improvement in CAFE to 20 MPG by 1980 and 100% by 1985, Congress set standards similar to what is before Congress today. The 20 MPG standard simply required the car companies to use known CAFE improvements just as does the 34 MPG CAFE standard under consideration today. Indeed Congress knew that 27.5 MPG would be difficult to reach by 1985 but set the standard based on the need of the nation to conserve energy. By doubling CAFE levels to 27.5 MPG, the 1985 standard forced technology just as would a 45 to 55 MPG CAFE standard for the year 2000 and beyond. The 34 MPG CAFE level is an intermediate goal that can and should be achieved within 4 years just as 20 MPG was achieved within 4 years. A redoubling of CAFE levels by 2000 will be difficult as was the initial doubling by 1985 but the need of the nation to conserve energy and reduce CO_2 emissions is even more important now than then and deserves no less resolve on the part of Congress.

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[3] Ford Motor Company Statement on S. 1903, Hearings on Energy Conservation Working Paper Before the Senate Comm. on Commerce, 93rd Cong., 2d Sess. 177 (1974).

[4] Id. at 141, testimony of Chrysler Vice President Alan G. Loofbourrow.

[5] Id. at 195, statement of GM Vice President H. L. Duncombe, Jr.

[6] Id. at 133-34.

TABLE

BENEFITS OF 4-VALVE PER CYLINDER TECHNOLOGY

	1988 Toyota Camry	1988 Ford Tempo	Change%* Camry to Tempo
Curb weight	2810 lb	2721 lb.	-4
Engine size	122 cu. in.	140 cu. in.	+15
Camshaft	DOHC	OHV	--
Valves/cylinder	4	2	--
Output power	115 HP @ 5200 RPM	100 HP @ 4400 RPM	-15
Torque	125 ft.lb @ 4400 RPM	130 ft.lb @ 2600 RPM	+4
Interior volume	89 cu. ft.	90 cu. ft.	~0
Trunk volume	12 cu. ft.	13 cu. ft.	+8
Transmission type	5-spd. manual	5-spd. manual	--
Axle ratio	3.74	3.73	~0
Performance (seconds)			
0-30 mph	2.9	3.3	+14
0-60 mph	9.2	10.8	+17
0-¼ mile	17.0	17.8	+5
30-50 mph (top gear)	14.2	14.6	+3
50-70 mph (top gear)	16.2	15.3	-7
Fuel economy (mpg)			
EPA city	28.8	23.1	-20
EPA highway	41.7	36.3	-12
EPA combined	33.3	27.6	-17

Source: "Car and Driver" and "EPA 1988 Test Car List."

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* Ford Tempo/Toyota Camry characteristics.

Senator **Bryan**. Thank you very much, Mr. Ditlow.

Ms. Bleviss, I thought I understood you to say in your testimony that you did find merit to the percentage reduction approach, which has been the subject of much colloquy between the witnesses and the members of the subcommittee. Could you in general terms construct what you think would be a realistic and an appropriate legislative model, including the percentage increase?

I mean, if you have a specific number in mind, fine. If not, just give us a hypothetical. But tell us how that model would appear in legislation that the Congress might adopt.

Ms. **Bleviss**. Actually, the bill that was introduced by Claudine Schneider in the House embodies a lot of my thoughts on this.

But basically, the goal would be, as I think all three of us would endorse, reaching an average fuel economy of the car fleet of about 45 miles per gallon by the year 2000. If you do that on a percentage-wide basis, you realize that that is about a 65 percent improvement over the current average fuel economy.

One of the differences between what I would do now and what was done ten years ago is that ten years ago the regulatory steps were established year by year from 1980 on. In 1980 you had to meet a certain level, 1981, 1982.

That also is not, I think, a realistic way to regulate the auto companies. You establish the increments every three or four years, so in three years you ask for an intermediate level of 25 percent improvement in their corporate average fuel economy of that particular fleet. You then raise it to 45 percent and eventually to 65 percent in the year 2000.

What that means is that if the fleet of a manufacturer today is 26, they have to improve 65 percent over 26. However, if the fleet fuel economy of a Japanese manufacturer is 33, they still have to improve 65 percent.

Senator **Bryan**. Well, that responds to the issue, which I must say I find of concern, that has been raised, that by simply achieving a flat level, whatever it is, it does not necessarily mean that one company has made the technological sacrifice or commitment than the other. So that addresses the competitiveness issue, it seems to me.

Ms. **Bleviss**. Yes, I think it does. I think the issue has unfortunately been somewhat overblown by the companies, but it is a very legitimate issue nevertheless.

Technology could have addressed a lot of the bias, and in fact if the companies had looked at the 27.5 miles per gallon as a challenge, they might technically be superior to the Japanese companies, since the Japanese companies did not have to work as hard.

But barring that, the percentage approach does address this problem of the full-line versus the small-line manufacturer.

Senator **Bryan**. Could you share with us again the fuel economy goals that you think are realistic? I think you used 45 fuel economy by the turn of the century?

Ms. **Bleviss**. Yes, I think a goal of at least 45 is a reasonable goal. There is, I know, a bill that has been introduced that would place a goal of about 34.

The concern all of us have is that you do not enact a regulatory process, you do not put in motion a regulatory process, unless it is going to do something. Today's average fleet fuel economy is 28 mpg if you include the foreign and domestics that are sold.

Going from 28 to 34 in ten years is not going to do very much either for CO_2 emissions or for reducing oil use. And it is not difficult to reach 34 technologically.

Sure, the auto manufacturers are going to have to gin up again after years of riding easy. But 45 mpg is quite doable, and it will do more for this country. If we set a low standard, we are setting ourselves up for a fall.

Senator **BRYAN**. I believe that Mr. Plotkin's testimony was by 1995, if I recall correctly, he was suggesting 33 miles per gallon. That is in a shorter period of time than a decade.

Is that a meaningful or a substantial improvement in your judgment, not ruling out a greater standard by the turn of the century? But his was, I think, in 1995.

Ms. **BLEVISS**. Yes, I think that the issue that the auto companies raise, that they are locked in right now for the next—it tends to grow in time period, how much they are locked in. But certainly for the next three to four years they have made a lot of product mix decisions.

So when you set a standard like this, you necessarily have to give them lead time. I think Clarence and I disagree as to how much lead time to give them. But the issue of setting a relatively low standard initially and then becoming more aggressive over time does have merit, so long as you make it clear that you are not going to roll back the tougher standards.

The problem we have had recently has been that the government has not expressed its intention of not rolling back, so the auto companies may not have taken seriously the technological challenge of moving beyond the 34 in 1995.

Senator **BRYAN**. Other comments?

[No response.]

Senator **BRYAN**. How about the technological investment made by foreign automakers, the Japanese and the Europeans, as opposed to what we are doing? There has been some testimony that we have really not been doing as much as they have.

Are they making product changes reflecting that technology? Is that technology to the marketplace yet, or is it still in a theoretical experimentation or testing phase? Anybody who wants to comment on that.

Mr. **DITLOW**. The Japanese clearly get the product to sales faster than the U.S.

Senator **BRYAN**. There is no question that they have been very effective. But specifically with respect to fuel efficiency technology?

Mr. **DITLOW**. In the fuel efficiency area, they certainly do get the technology there in a year to two years faster. They do spend more on R&D and innovation than do the domestic companies. What Debby said about inventors is absolutely true.

Senator **BRYAN**. Do we have some data on that, Mr. Ditlow? I do not mean to interrupt you. But you are saying that they spend more on R&D than we do. Do we have some data?

Ms. **BLEVISS**. If I might add, it is the percentage of their sales. They spend a larger fraction of their sales. Our manufacturers tend to spend about two to three percent of their profit, whereas the Japanese are up to about five and greater.

Senator BRYAN. I see. Have you included that in your more detailed testimony?

Ms. BLEVISS. It is in my book. It is not in my testimony here.

Mr. DITLOW. I would be glad to submit some information on that.

Senator BRYAN. Would you as well? I cut you off and I did not mean to preclude further comment or observation that you might have.

Mr. DITLOW. No, I had concluded the point about how the Japanese are certainly much faster than are the domestic companies in getting their technology on the market.

Ms. BLEVISS. You know, a good case study is the continuously variable transmission. This is something that Ford initially expressed a lot of interest in, has done a lot of testing. There was a problem with—they are called CVT's—the CVT belts and the belt manufacturer, who was in Europe, had problems with breakage, et cetera, et cetera. And it was at an impasse for five years.

We have been told that Ford and Fiat were going to bring them out for five years. Interestingly enough, it was Subaru who went in, in essence bailed out the European company, and is now producing a cut in car, which has just been introduced into this country.

The Subaru Justy has a continuously variable transmission. It is not in widespread production yet by Ford. So that is a good case study of how the Japanese move past a lot of the hangups about risk, et cetera, et cetera, and bring on a product very quickly.

A CVT is a more efficient transmission design than current types of transmissions—automative transmission—on the market.

Senator BRYAN. Senator, I think I have warmed the panel up for you.

Senator GORE. Well, I apologize for having to momentarily leave and I hope I do not cover too much of the ground that has already been covered.

I am told, Ms. Bleviss, that you endorse the concept of legislation to raise CAFE standards on a percentage basis to 45 miles per gallon by the year 2000. I do not know if you are aware that S. 201, which Senator Bryan and I introduced on the first day of this session, embodies precisely that concept.

I take it that you are in favor of that provision of S. 201, is that correct?

Ms. BLEVISS. Yes, yes, I am.

Senator GORE. All right.

What is the advantage of this variable transmission you were just discussing? What kind of improvements can come from that particular product?

Ms. BLEVISS. Well, the verdict is still out on it, but basically what it does is it can enable a car to get the fuel economy of a manual transmission with something that is an automatic. In other words, you do not have to shift it. It is automatically shifting.

Today there is a discrepancy between the fuel economy of automatic transmissions and those of manual transmissions. If you drive a manual well, if you know how to drive it well, it gets a vastly superior fuel economy to an automatic. A CVT will make the two equivalent.

Senator Gore. I want you to quantify it, though. What is it?

Ms. Bleviss. It is very hard to quantify because of difference in transmission designs, but anywhere from a 10 to 20 percent impact, depending on the type of automatic that you are comparing.

Senator Gore. What other—if you were going to rank the technological bottlenecks or, to look at it a different way, the technological advances that could push us past the bottlenecks, which would be the most important ones in getting large increases in fuel efficiency? Whoever wants to go first.

Mr. Ditlow?

Mr. Ditlow. Well, I would have to say that the two things that stand out the most are the change to a different type of power plant, whether it is a direct injection diesel engine or, as I say, the orbital engine that is under development in Australia. If one of these could be put into production in this country, it is a displacement technology, you would have to displace present engines, but it offers perhaps the biggest improvement in fuel economy.

Senator Gore. How large an increase?

Mr. Ditlow. If you take full advantage of it, including the lighter weight, you are looking at 20 to 40 percent improvements in fuel economy easily.

Senator Gore. 20 to 40 percent.

Okay, what is next on your list?

Mr. Ditlow. After that, perhaps material substitution, lighter materials that could be utilized.

Senator Gore. Like carbon fibers?

Mr. Ditlow. Carbon fibers. And then after that improvements in transmissions, reduction of what they call parasitic losses in vehicles. If one takes all of these and puts——

Senator Gore. What do you mean, "parasitic losses"?

Mr. Ditlow. Air conditioning, making it more efficient.

Senator Gore. We are going to have to change them anyway. No, I am serious, I am dead serious.

And they will have to change even faster than the rest of the automobile, there is no question about that.

Mr. Ditlow. That is quite correct, Senator Gore.

Ms. Bleviss. And this is an example, Senator, of how for two different reasons we are pursuing goals that are mutually compatible.

Senator Gore. Yes, yes. The opposition is united also.

Ms. Bleviss. I know.

Senator Gore. Okay. Would your list differ, Mr. Ledbetter?

Mr. Ledbetter. I would mention the area of part-load improvements. The automobile engine when operated at full load is a fairly efficient device. But we lose a lot when that engine is operated at part load. And strategies and technologies that enable the engine to operate at closer to full load will have a very substantial effect on fuel economy.

One of the very promising technologies that has very recently been commercialized, but not optimized for fuel economy, is variable valve timing. I believe it was one of the Japanese companies that just came out with a car with variable valve timing. It was an Acura.

Senator GORE. This is one of the advances that comes from microprocessors?

Mr. LEDBETTER. No, it is a mechanical device.

Senator GORE. Purely mechanical?

Mr. LEDBETTER. Yes.

Ms. BLEVISS. Yes, but it is electronically controlled.

Senator GORE. It does not depend on microprocessing control?

Mr. LEDBETTER. Well, I guess there are different versions of variable valve timing. The one that I have read about is strictly a mechanical device. Debbie said that she has heard about one that is electronically controlled. You are saying the one in the Acura is electronically controlled?

Ms. BLEVISS. No, no, I do not think it is.

Mr. LEDBETTER. Okay.

Senator GORE. Have any of you seen discussions of applications of what they call microdynamics or nanotechnologies in this field?

Ms. BLEVISS. I do not think it has even been thought about being applied. The automotive technology field tends to lag behind almost everything else, and that is one of the problems with looking at fuel economy improvements in the first place.

I would just add one other point when you talk about technological leaps. Marc referred to it, and that is a near-term solution. Part-load is a big problem. When an engine operates in part-load, which in an automobile is most of the time, it is a fairly inefficient device.

One of the most interesting applications which occurred during the height of the oil crisis was that Volkswagen developed a device which essentially would enable the engine to be turned off when it was in a deceleration mode. That is, when you are just coasting along, when you have taken your foot off the accelerator, it would essentially transmit the engine energy to a flywheel and then shut the engine off.

The interesting thing was that VW was going to introduce this device in California because it figured the California market was the market to demand this. But then VW perceived that consumers did not want it any more. So the technology currently is sitting in their prototypes back in Germany. That was something that was ready to come to market and is not currently in the market.

Senator GORE. Are there any U.S. energy efficient technologies that could, if developed, find markets overseas?

Ms. BLEVISS. I think that the natural area where the U.S. could play a major role is in plastics, and particularly in plastic body parts. That has been an area in which the U.S. has had a strength.

I note, however, that the Japanese and the Europeans have both played with introducing plastic parts in their cars. It is currently a strength of the U.S. industry. The question is really how aggressive the industry goes about introducing plastic parts in the future. Only GM has introduced a car so far with plastic body panels.

Senator GORE. Now, the part-load—would you add any other items to the list that Mr. Ditlow and Mr. Ledbetter have constructed here?

Ms. BLEVISS. Aerodynamics is about, I think, the missing area.

Senator GORE. Aerodynamics.

Ms. Bleviss. Yes. That is a relatively cheap technology. And again I might add that the most aerodynamic car designed in the world today is designed by Ford. It is called the PROBE, and that has the aerodynamic drag of an F-15 military jet.

But we have not seen that translated into the production cars.

Senator Gore. Well, what kind of fuel efficiency improvements can be made there? Are we not at the point of diminishing returns on aerodynamic gains?

Ms. Bleviss. No, we are not, actually. Clearly where you see the gains is in highway fuel economy, not necessarily in city fuel economy. And you see gains on the order of—for every ten percent improvement in aerodynamic drag you see something like a 4 to 6 percent improvement in highway fuel economy.

So it is a significant improvement, and right now——

Senator Gore. But before you leave those numbers, when you say ten percent, of what? I mean, how much of the base has already been used up?

Ms. Bleviss. Well, that is what I was just going to point out. The average aerodynamic drag now of the U.S. fleet is something in the range of—no one has done a good analysis of this—0.35 to 0.4. It used to be about 0.45 a decade ago, so we have improved.

The best cars on the market today are about 0.3, and the Ford PROBE gets 0.137. So there is quite a range left to explore.

Senator Gore. Okay. Well, very good. Anything else on the list?

Ms. Bleviss. Not off the bat.

Senator Gore. Probably several things that nobody has thought of yet.

Ms. Bleviss. Exactly.

Senator Gore. That will be the most important.

Ms. Bleviss. I might just add, ceramics is one technology, particularly in tandem with diesel engines, that began to be looked at here and that the Japanese are running away with it at this point.

Senator Gore. Let us say that the three of you were given the task of creating from scratch a personal transportation vehicle and a family transportation vehicle system. You are given the U.S. highway and road network and you have carte blanche otherwise to design an efficient, safe system for personal and family vehicle use.

How would you go about it? How would you do it?

Mr. Ditlow. You know, I would start with the Department of Transportation's Research Safety Vehicle program back in the late 1970's, where they had a four-passenger vehicle that had a demonstrated fuel economy of 50 miles per gallon in a combined cycle and a five-passenger vehicle that had 43, and this was technology of ten years ago.

That had safety levels—it provided against injury in 80 miles per gallon frontal closing crashes, 50 mile an hour side, 45 miles per gallon rear, and protected pedestrians from injury at levels up to 20, 25 miles per gallon, or at least reduced them.

And that vehicle could just simply be put on the road system as we have it today. One can take a look at changing the road system that we have, allocating some roads strictly for 1500 pound vehicles. If one gets into really lightweight ones, that is what you have to do.

Senator **Gore**. We will get to the point where we soon recognize, in my opinion, that 50 is not going to be nearly good enough.

Mr. **Ditlow**. Oh, that is absolutely right.

Senator **Gore**. And that vehicle does not have the potential, does it, to give us——

Mr. **Ditlow**. That vehicle, if we had not stopped—one of the greatest tragedies is we stopped that program. If we had continued that program and incorporated the technologies that we now have available ten years later, and then look out say ten years beyond it, I think you would be looking at vehicles that have 75 to 100 miles per gallon capability, with adequate safety.

Senator **Gore**. Okay. Anybody else want to respond?

Ms. **Bleviss**. Let me. What you are asking for is what kind of technologies we would see in such a vehicle if we were going to design it?

Senator **Gore**. No, I am asking for more than that. I am asking for a completely new approach to the underlying problem. If we assume that the road network and the pattern of our cities and suburbs is going to remain relatively constant for a while—and we will get to the point, we may very well get to the point, where that has to change as well, and perhaps sooner rather than later.

But if one makes the assumption that that pattern is static and then focuses on the pattern of vehicle transportation, the entity here, how are we going to allow these people and families to move in personal and family vehicles along that road network with vastly greater fuel efficiency than now exists?

Rather than just taking the incremental approach, which we have got to do, and the Chairman and I are committed to that, let us think beyond that just for a moment, because I am convinced we are going to very quickly get to the point where we have to do this.

If you started from scratch, what would you do? What kind of system would you come up with?

Ms. **Bleviss**. None of us are automotive engineers, so I think we cannot address the specifics. If I can just make a couple of comments, I think all of us agree that you have to think of this not in incremental steps, and all of us are as frustrated with the incremental approach as you are, Senator.

But the first approach must be how can we design a car that gets a significant improvement in fuel economy? And that means to a large extent going back to the drawing board. Nevertheless if we are talking about something that we want to see on the road say by the end of the century, we are still working with fairly conventional technologies.

Senator **Gore**. Right.

Ms. **Bleviss**. The types of technologies I think that we have to be addressing is not using, for example, the gasoline-driven engine design of today, but looking at stratified charge designs, looking at direct injection diesel designs. We have to look at the transmission and improvements in the transmission. There are a lot of changes that have occurred on that route, the CVT being one.

We have to look at improved aerodynamics. We have to look at energy storage systems.

That exercise was gone through before. Unfortunately, all the examples we are giving you go back to the last time people were worried about fuel economy.

Senator GORE. What about the fuel base? What about the fuel base?

Ms. BLEVISS. I was just going to reach that. The problem that we have at this point when we talk about alternative fuels is the only type of alternative fuels that make sense from a CO_2 perspective are those that are either biomass-derived or are electrical and we then have to ask where the electricity is coming from and do we want more nukes, et cetera, et cetera.

But let us leave that aside for the moment. When you go to biomass——

Senator GORE. That is the same with hydrogen?

Ms. BLEVISS. Well, that is right, how you produce the hydrogen.

Senator GORE. Right.

Ms. BLEVISS. But let me go back to the biomass, which for the shorter term is the most likely. We can produce a vehicle running on a biomass fuel by the end of the century which meets other consumer amenities. We cannot do that yet with electricity or hydrogen.

If we go to a biomass vehicle, we are not going to be able to back out a significant proportion of our petroleum use with biomass fuels at this point because we guzzle so much fuel.

We have to improve the efficiency of those vehicles first, to get the overall demand down, and then we can significantly shift to biomass. If we shift to biomass now, we are essentially going to go through our biomass reserves very quickly. We cannot keep up the renewability of the biomass reserves.

So the two have to go hand in hand. We have to get efficiency in hand with biomass in order to meet the CO_2 challenge.

If we pursue the alternative fuels, the ethanol, methanol, which today is made from natural gas and so does not solve the CO_2 issue, but if we were to pursue that without the——

Senator GORE. Well, the conversion—go ahead.

Ms. BLEVISS. There are many people who feel that the conversion means the CO_2 release from natural gas-produced methanol is about the same as that from gasoline. Even if it is slightly less, we are not significantly making a dent in the problem.

The issue is, in order to get CO_2 emissions down and get to alternative fuels, we have to turn to the efficiency route in combination with biomass.

Senator GORE. Anybody else?

Mr. DITLOW. Yes. With the alternative fuels, the first issue is you have to improve the efficiency of the process. You have got to get the Btu's per mile traveled down. Otherwise you are going to be generating the same levels of carbon dioxide.

If one goes further and looks at the sources, particularly with methanol, methanol from natural gas may be a wash, but if you go to methanol from coal you would be practically doubling carbon dioxide emissions for the same level that you would get with gasoline.

Senator GORE. With the current conversion technology?

Mr. DITLOW. With current conversion technology. But even if you did substantially better, I have not seen anyone who would suggest that we could get it down to the same level as gasoline if we went to coal.

But the big issue that has been simply missed in alternative fuels is people seem to think that it is a free energy situation, once again, that we do not have to look at energy conservation. We have to go to energy conservation first.

One of the things energy conservation does is it buys you time to substitute another fuel. In the long run I think we have to pay more attention to renewables, particularly to solar. We have to take a look at electric to see what we can do about it, because you simply, on liquid fuels in the urban areas, the increase in numbers of vehicles and BMT is just working against you.

Senator GORE. I have taken much more than my allotted time, Mr. Chairman. Thank you.

Senator BRYAN. Most interesting and enlightening, Senator. I appreciate it.

Let me just go back to one more question that I had. That is in R&D, and you made a comment, I think, Ms. Bleviss, and used a comparative basis in terms of a percentage of sales. Can you give us something that is just a little bit easier for us to sink our teeth in, in terms of dollars.

I mean, I presume that you are suggesting, and I think each of you have in one form or another, that the Japanese and the West Europeans are spending more dollars on research technology on fuel efficiency than we are. Is that a correct statement or have I misinterpreted your comments?

Ms. BLEVISS. No. I think that, unfortunately, we do not have a good measure of how much they are spending on fuel economy research. All we can do is judge how much they are spending based upon what is coming out at the end of the line.

In terms of overall dollars spent on research and development, no one touches General Motors. They have the largest R&D budget in the world of any automotive company. Nevertheless, if you look at, for example, the number of patents that have come out, you will see that they are bested by Toyota and Nissan.

So the question of how much money produces how much technology is a big question. That is why we have turned to other types of indicators to try to assess how much of the efforts at R&D are turning into something.

Senator BRYAN. Well, I suppose you could make an assumption from that that, although they may have the largest budget, maybe they are not allocating their resources for fuel efficiency technology. There are many aspects of R&D, I presume, in that budget.

Ms. BLEVISS. There are, and I have had discussions with the R&D folks at all three companies; and you are right, there is a problem with allocation of dollars. That is why all of us have endorsed, among other things, that the Federal government needs to look at the whole R&D area as well.

It is not just CAFE we have to look at. We have to make certain that R&D is being pursued so the technologies can come forward to meet the CAFE levels.

Senator **Bryan**. Well, I would like to thank the panel very much for your time and for your constructive testimony and response to our questions.

The subcommittee hearing today is adjourned and we will be in recess until the call of the chair.

[Whereupon, at 12:58 p.m., the subcommittee was adjourned.]

ADDITIONAL ARTICLES, LETTERS, AND STATEMENTS

SAAB-SCANIA OF AMERICA, INC.
COMMENTS TO THE CONSUMER SUBCOMMITTEE OF THE U.S. SENATE COMMERCE, SCIENCE AND TRANSPORTATION COMMITTEE ON GLOBAL WARMING AND CORPORATE AVERAGE FUEL ECONOMY STANDARDS

MAY 26, 1989

INTRODUCTION

Saab-Scania of America, Inc., headquartered in Orange, Connecticut, imports Saab cars and Scania heavy trucks. It is a part of Saab-Scania AB (hereafter Saab), Sweden's high-technology automotive and aerospace manufacturer.

Saab appreciates the opportunity to comment on the issue of global warming and Corporate Average Fuel Economy (CAFE) standards. The Consumer Subcommittee provides an excellent forum in which the auto industry can express its views on fuel efficiency and regulatory policy. Saab trusts this forum of open dialogue and understanding on this issue will continue.

The Subcommittee and the entire Congress must recognize that both the auto industry and Saab specifically are doing and have done our part to achieve the goals of the Clean Air Act and to improve the fuel efficiency of motor vehicles. Also, the industry is now focusing on the most meaningful and effective methods of addressing global warming through development of non-CFC based air conditioning systems.

Global warming is, by definition, a global problem. Saab encourages the Congress, when addressing the issue of CAFE standards in the United States, to consider the minute impact on carbon dioxide reduction that increased standards would have, not only in the United States, but more specifically on a global scale. CAFE standards, at any level, **will not** by themselves impact global warming via reductions in carbon dioxide emissions.

Existing CAFE standards and regulations are ineffective, inefficient and discriminatory. Saab supports these comments as follows.

HOW ARE CAFE STANDARDS INEFFECTIVE?

First, CAFE standards do not have an impact on the consumption of gasoline in the United States nor the public's perception of the ready availability of gasoline.

Second, since CAFE standards have not served to reduce gasoline consumption via reduced vehicle miles travelled (VMT), levels of carbon dioxide production from mobile sources will not be affected by draconian increases in CAFE standards.

Third, changes in consumer preference offset fuel economy improvements. Consumer preference and their driving habits are beyond the control of the auto industry. The availability of ample supplies of gasoline and the relatively low price of gasoline has resulted in greater consumer demand for large, performance oriented cars and power consuming items such as automatic transmissions and air conditioners. Therefore, CAFE is not a good measure of nor a driving force behind the implementation of technology for the sole purpose of improving fuel efficiency.

Fourth, gasoline prices are projected to be at levels in the next decade that will not shift consumer preference as it exists today.

HOW ARE CAFE STANDARDS INEFFICIENT?

It is an accepted premise that CFC's and carbon dioxide are the principal greenhouse gases. New technology is currently being pursued to control CFC's. Although mobile source production of carbon dioxide from new cars in the United States comprises only a fraction of total global production of this gas, the only efficient way of controlling this source is to limit the number of miles that the public drives their cars.

The most efficient method of controlling the number of miles driven is for the motoring public to voluntarily practice energy conservation on a mass scale. Absent this public awareness, regulatory policies increasing the cost of driving would produce the same effect without loss of efficiency.

There has been **no evidence** produced since the passing of the Energy Policy and Conservation Act confirming that CAFE standards have any impact on the driving habits of the American public. Given the attitude of Americans' unwillingness to compromise their preference for large, performance oriented cars, it is highly unlikely that a car designed for the sole purpose of fuel efficiency would be successful on a mass scale. The retail price of these cars would be necessarily inflated due to high development costs. The public would prefer to delay the purchase of a new car in deference to owning a larger, safer, less expensive and yet, less fuel efficient vehicle.

Therefore, it is Saab's premise that regulatory policy based on increased CAFE standards to combat global warming is wrought with inefficiency, in that CAFE standards have no relative impact on the overall control of greenhouse gases, specifically carbon dioxide, produced from mobile sources in the United States. Increased CAFE standards ranging from 33 - 50 mpg that are currently being proposed to the Congress with short lead times for implementation would place sizeable and disruptive burdens on the economy which are unnecessary, in light of the availability of alternative and more efficient methods of controlling green gases.

HOW ARE CAFE STANDARDS DISCRIMINATORY?

First, CAFE standards discriminate against **small-volume and limited-line manufacturers**. CAFE is a sales-weighted value. For example, Saab markets a limited number of engine families and vehicle variants in the United States within a small and very defined market segment and it falls under the common definition of **limited-line manufacturer**.

Saab's development and engineering resources, production capacity, distribution network and marketing objective preclude it from offering a broader product line which might include smaller cars with lower fuel consumption produced for the sole purpose of fleet averaging to improve its CAFE. Similarly, limited production volumes mandate that Saab set a deliberate, cost effective course in the evolutionary development of existing models and keep product lines in production for comparatively long model runs, typically ten years or more to ensure investment returns. Furthermore, the ready availability of gasoline at relatively low prices frustrate any manufacturer's attempts to shift its product mix to more fuel efficient vehicles. A shift to smaller vehicles is not possible for Saab.

Second, Saab has established a solid reputation in the United States and its other world markets for manufacturing safe, efficient and reliable automobiles. It will continue to build on this reputation and must do so to remain competitive. Saab is dedicated to front wheel drive and four-cylinder engine technology with multiple valves per cylinder and multiport electronic fuel injection. Saab has always built front wheel drive cars. The Saab 9000, introduced in the United States in 1986, is by EPA's definition a large car which achieves, on the average, 26.0 mpg, yet still achieves a speed of 60-mph from rest in 7.5 seconds. Increased CAFE standards discriminate against manufacturers such as Saab which have done their part to improve fuel efficiency in light of current market demands.

Third, CAFE standards by themselves, can address only a small source of the total production of carbon dioxide;i.e., they are applicable only to new cars, a small part of all sources of carbon dioxide production. In light of the uncertainty of the exact relationship between the increase of the level of carbon dioxide in the atmosphere, the primary sources from which the increase is due, and global warming, regulations that attempt to control carbon dioxide production from such a small segment of the total, would appear premature and discriminatory.

CFC CONTROL -- THE MOST EFFECTIVE MEANS OF COMBATING GLOBAL WARMING

Sweden has enacted regulations on the control of CFC use that are more stringent than the recommendations of the Montreal Protocol. Saab is aggressively pursuing new technology which will allow for the eventual phase-out of all CFC-based air conditioning systems in its cars and is focusing on development of procedures for recycling refrigerants in the workshop. These regulations pose a major and costly technological challenge to Saab and the auto industry.

ALTERNATIVES TO CAFE

CAFE does not affect VMT or gasoline consumption and targets a source representing a minute share of any forecast global warming impact. Congress should refocus its attention away from CAFE toward more pertinent solutions and work with the industry in a cooperative and not an adversarial fashion to combat the production of greenhouse gases.

A "carbon fee" would broaden the focus of carbon dioxide reduction. The fee would affect all vehicles, not just new vehicles covered by CAFE standards, and it would affect all other sources of carbon based fuel consumption in the U.S. If the fee was significantly high, consumer decisions would be shifted in a positive direction toward fuel conservation.

Saab does not agree with a manufacturer-specific percentage based CAFE as a viable alternative due to its discriminatory nature. Manufacturers that have done their part toward increasing the fuel efficiency of their cars would be penalized by such an alternative.

It should also be noted that the Corolla Sedan and Camry are made in the United States, and an engine plant to supply 4-valve per cylinder engines for the Camry is under construction in Georgetown, Kentucky. In addition, Toyota has announced that its very fuel-efficient light-duty truck will be produced in Fremont, California. Production of this vehicle will begin in 1991.

In 1988, representatives of Energy and Environmental Analysis, Inc. (EEA), a contractor to OTA, prepared a report entitled "Developments In The Fuel Economy of Light-Duty Highway Vehicles." Although Toyota has certain differences with the EEA estimates of fuel economy improvements for some of the technologies discussed in this report, on the whole, the analysis contained in the EEA report is reasonable and practical. Thus, it provides a sound basis for examining existing and future technologies.

Figure I shows EEA's estimate the technologies that can be employed to improve U.S. fleet average fuel economy levels for 1995, and the technologies that have been adopted on the current model Camry, Toyota's leading selling U.S. model. As can be seen, virtually all the technologies listed as being available for the U.S. fleet in 1995 have been employed in the existing Camry model.

Figure II shows that in addition to the technologies used on the Camry and the multi-valve engine design used on all Toyota passenger cars, current Toyota vehicles utilize many, if not most, of the technologies OTA has listed as being available to improve fleet-wide fuel efficiency. These technologies include: front-wheel drive; electronic multi-point fuel injection; overhead cam engines; 4-speed automatic transmissions; 2 stage accessories (e.g., air conditioners); low friction pistons and piston rings; variable assist power steering; and aerodynamic body designs.

As Figures I and II, and the description of advanced technology employed by Toyota show, Toyota has not simply relied on the size of its vehicles to achieve high fuel economy levels. Toyota's commitment to quality includes incorporating state-of-the-art technology in the full range of our vehicles.

TOYOTA WILL CONTINUE TO UTILIZE ADVANCED TECHNOLOGY IN THE FUTURE, BUT MAJOR FLEET-WIDE IMPROVEMENTS ARE UNLIKELY

Toyota is not resting on its past technological advances. We have an active research program underway in all aspects of vehicle design. Figure II is taken from the EEA report. It shows a list of potential fuel economy technologies, and it gives EEA's assessment of the status of the techology, as well as Toyota's efforts to implement or examine each of these technologies. From this list there are only three technologies which Toyota believes would result in fuel economy improvements of 10% or greater. These are:

(1) Diesel Engines - The low market demand for diesel engines and diesel powered vehicles indicates they are not popular in the U.S. In Japan, the market share of diesel

powered vehicles is only 6%. Furthermore, it is difficult given current diesel technology to bring diesel engines into compliance with emission standards. Diesel engines cannot, for example, meet current California standards. Proposals for even more stringent NO_x standards for passenger cars which have been recently introduced (e.g. H.R. 2323) will, if adopted, greatly limit the use of this technology in the U.S.

(2) Lean burn gasoline engine - Toyota is making great efforts to develop lean burn gasoline engines. We were the first to perfect the lean sensor feed-back system and to adopt it for Japanese and European models. Lean burn systems have a great ability to improve fuel economy, but because a three-way catalyst is not effective in reducing NO_x emissions in such a system, it has not been used for our U.S. models. This is due to the strict U.S. NO_x emissions standards. As noted above, the possible imposition of even more stringent NO_x emission standards will adversely affect the potential use of this engine in the U.S. unless further technological breakthroughs can be made.

(3) CVT (Continuously Variable Transmission) - Toyota has on-going efforts to develop the CVT technology. However, we do not believe this technology can be used on our production vehicles at this time. We also believe CVT can be introduced on only small vehicles because of insufficient belt durability. Research is continuing in order to overcome this problem.

As can be seen from Figure II, many other technologies which have good fuel efficiency benefits have already been adopted. The remaining technologies have significant problems that must be resolved before they can be utilized.

Some proponents of unrealistically high fuel economy standards have made reference to Toyota's Advanced Experimental Vehicle (AXV) as proof that high CAFE standards can be achieved. However, it must be pointed out that this vehicle is a concept car. That is, a vehicle which tries to push technology to the limits and see what ideas may and may not have commercial viability.

The AXV vehicle has been designed to incorporate major innovations including: a direct injection diesel engine; CVT transmission; use of new lightweight materials; and, streamlined styling which results in a coefficient of drag of 0.26. A comparison of this vehicle to our current Tercel model is contained in Figure III. As pointed out above, this is an experimental/concept vehicle, as opposed to a prototype vehicle (which is much closer to actual production). In other words, far more research and evaluation must be undertaken before one or all of the advanced concepts incorporated into this vehicle can be utilized in production vehicles. This is the very reason for designing this type of vehicle. The difficulties in incorporating the innovations of AXV into production vehicles are shown in Figure IV. Therefore, while this vehicle represents a very advanced design, it is far too early to determine what features may be incorporated into future production vehicles.

The Subcommittee should also keep in mind that new safety and emission standards are likely to have a negative impact on fuel economy. The full Commerce Committee has recently approved S.673, which would impose new safety standards that will lead to a weight increase in all vehicles. Both Houses of Congress are considering Clean Air Act amendments, which would impose tighter emission standards. EPA also has proposed to require on-board refueling control systems that will both complicate the task of controlling tailpipe emissions and could cause safety problems in vehicles.

PROPOSALS TO REQUIRE UNIFORM PERCENTAGE INCREASES IN EACH MANUFACTURER'S CAFE LEVELS: "NO GOOD DEED GOES UNPUNISHED"

There are proposals in several bills that address global warming to require uniform percentage increases in fuel economy from each manufacturer's 1988 base level. Not only are the percentages proposed unrealistically high, but more fundamentally, the concept of a uniform percentage increase applied to each manufacturer's existing CAFE level is seriously flawed.

The assumption underlying this approach assumes that an equal burden will be placed on all manufacturers. This assumption is invalid. Indeed, the more technologically advanced a manufacturer is at this time, the harder it will be to achieve additional increases in fuel economy. That is, if a manufacturer has already made significant commitments to technology, there is little left that will not require either more advanced technology or production of vehicles which will not meet consumer demands. To put it bluntly, this approach penalizes those who are most advanced and benefits those who are not as advanced.

A uniform percentage increase is less likely to require all manufacturers to employ the highest level of technology for each type of vehicle. Uneven additional burdens will give those manufacturers with a lower base less incentive to employ the most effective designs and technology for reducing fuel consumption. In addition, even if manufacturers with lower CAFE levels shift production and marketing efforts toward smaller vehicles, the resulting difference in CAFE levels would allow less then optimum technology to be utilized in order to reduce costs to consumers. If this were to occur, the manufacturer who had used more advanced technology in the past would be penalized in the market due to its efforts.

OTA's testimony to this Subcommittee contained an analysis of what level of fuel economy would be expected from different manufacturers taking into account their vehicle mix. Toyota was significantly ahead of what OTA could have expected, based on Toyota's 1988 vehicle mix. A copy of the OTA chart is Figure V.

The adoption of this type of approach will destroy any incentive a company will have to exceed the standard set for it in the future. As demonstrated above, the reason for

Toyota's positive variance from what could be expected is advanced technology, not vehicle size. Toyota has made substantial efforts, but the uniform percentage increase approach would penalize us for having taken these steps. One must ask why would any company have any incentive to exceed its standard in the future if this approach is adopted.

Conclusions

While Toyota urges the Subcommittee to consider a broader-based approach to address the global warming problem, if changes are to be made to the CAFE program, they should be fair to all manufacturers. For the reasons discussed above, Toyota strongly opposes uniform percentage increases that are applied to each manufacturer.

The Subcommittee should consider other means to address the concerns expressed by other manufacturers, as well as Toyota, regarding the impact of CAFE on marketplace decisions. Whether any approach is viable is yet to be determined. Before endorsing any proposal, the Subcommittee should carefully consider its impacts on consumers and manufacturers, as well as on CO_2 emissions. Toyota will be happy to assist the Subcommittee in any way possible as alternatives are being considered.

Toyota thanks the Subcommittee for the opportunity to present these comments.

FIGURE I Discussion on '95 Model Fuel Economy Improvement

EEA Estimate of MY 1995

Fleet Average Fuel Economy Improvement

Technology	% F/E Gain	% Penetration Increase 1987-1995	Fleet % F/E	Toyota Ca
Front-wheel drive (includes weight reduction)	12.0	10	1.2	Adopte
6/4-cylinder/4-valve	10.0	40	4.0	Adopte
Four-speed automatic	7.5	40	3.0	Adopte
Electronic transmission control	1.5	75	1.1	Adopte
Aerodynamics II (CD = 0.34)	3.4	80	2.7	Adopte
Tires	0.5	— 100	0.5	Adopte
Lubricants (5W-30)	0.5	100	0.5	Not Adopte
Accessories	1.0	100	1.0	
Engine improvements				
- Overhead camshaft	6.0	10	0.6	DOHC
- Roller cam followers	1.5	80	1.2	N/A
- Low friction rings/pistons	2.0	80	1.6	Adopted
- Throttle body fuel injection	3.0	10	0.3	N/A
- Multipoint fuel injection	6.0	10	0.6	Adopted
Total			18.3	33 mpg

Source: Energy and Environmental Analysis, Inc.

FIGURE II Technology Assessment for Fuel Economy Improvement
Summary of Available Technologies

Technology	EEA estimate Fuel Economy (Percent Gain)	EEA Status	Toyota's estimated Fuel Economy (Percent Gain)	Toyota Status
Engine Technologies				
OHC 4/6 cylinder	5 (over OHV engine)	Widely available in most imports, few domestic vehicles	N/A	Used in 100% of passenger cars
Roller cam followers	1.5	Recently (1985-1986) introduced in some engine lines	2-3 %	Used on some engine families More effective at lower speeds
Friction reduction (piston, rings)	1+1	Widely utilized in domestic and import vehicles	Same as EEA	Used in 100% of passenger cars
High swirl combustion chambers with CR increase	4 (Over typical 8.5 CR engine)	*	N/A	Used in some trucks and in Japan
4-valves/cylinder	10 (at constant performance over 2 valves/ cylinder engine)	Used extensively by Toyota, limited otherwise	4-5 %	Used in 83% of passenger cars
Intake valve control	4 to 8 (depending on transmission)	Post-1995 technology	4-5 %	Future technology - currently there is no good mechanism to accomplish this

* Percentages based on sales data.

Technology	EEA estimate Fuel Economy (Percent Gain)	EEA Status	Toyota's estimated Fuel Economy (Percent Gain)	Toyota Status
Lean burn	5 (over stoichio-metric operation)	Potential introduction in early 1990's	10 %	U.S. NOx emission std. is critical
Two-stroke engines	unclear (10-20 ?)	Post-1995 technology with substantially reduced cost	unclear (0-5 % ?)	Future technology - Direct injection is a key technology
Diesel (I.D.I)	30 (over 1981 gasoline engine)	Currently unpopular in marketplace	15 %	Available technology but unpopular with consumers
Diesel (D.I)	45 (over 1981 gasoline engine)	Post-1990 technology	30 %	Difficult to use small engines
"Adiabatic" D.I. Diesel	60 (over 1981 gasoline engine)	Post-2000 technology	30 %	Not a practical technology
Power Boosting Technology				
Turbocharging	5-10 (constant performance)	Limited use in luxury/performance cars	0	High performance technology used in 2%* of passenger ca
Comprex	8 (constant performance)	Available only in Europe	0	High performance technology

* Percentages based on sales data.

Technology	EEA estimate Fuel Economy (Percent Gain)	EEA Status	Toyota's estimated Fuel Economy (Percent Gain)	Toyota Status
Supercharging	8 (constant performance)	Introduced in 1988/90	0	High performance technology used ir 0.4% of passenger ca
Fuel Injection (Throttle-body)	3 (over carbureted engine)	Widely used in domestic vehicles	0	Used in Japan
Fuel Injection (Multi-point) w/ tuned intake manifold and deceleration fuel shutoff	6 (over carbureted engine)	Widely used in imports, domestic, luxury vehicles	0	Used in 52% of passenger cars
Idle Speed Control	1	Widely used	Same as EEA	Used in 51% of passenger cars
Engine Stop/Start	5-6	Researched by Volkswagen in Europe	Same as EEA	Used previously in one Toyota model in Japan- discontinu- due to poor sales
Shift Indicator Light	2	Widely used	Same as EEA	Actual improvement is unclear
Knock Limiter	2-4	Limited use, (CR increase by 1) potential market penetration limited	2-3 %	Used in 6% of passenger cars

* Percentages based on sales data.

Technology	EEA estimate Fuel Economy (Percent Gain)	EEA Status	Toyota's estimated Fuel Economy (Percent Gain)	Toyota Status
Transmission Technologies				
Electronic Transmission Control	1.5	1990 technology	About 6 %	Used in 44% of passenger cars (within automatic transmission)
Torque Converter Lock-up (TCLU)	3.5	Declining penetration due to NVH (noise, vibration, harshness)		Used in 100% of passenger cars (within automatic transmission)
Overdrive	5-7.5	Current penetration 50 %		Used in 92% of passenger cars (including manual transmission)
Continuously Variable Transmission	10 (over 3-spd auto. w/o TCLU)	Limited introduction in Europe	10-15 %	Future technology - limited to small vehicles only
Parasitic Loss Reduction				
Lubricants I (Multigrade 10W-40)	2 (over 30W)	Used since 1980	N/A	Used in 100% of passenger cars
Lubricants II (Multigrade 5W-30)	3 (over 30W)	Used on several models	1-2 %	Will introduce shortl
Lubricants III (Synthetic)	4 (over 30W)	Post-1995 technology	N/A	Can not be used in certification test

* Percentages based on sales data.

Technology	EEA estimate Fuel Economy (Percent Gain)	EEA Status	Toyota's estimated Fuel Economy (Percent Gain)	Toyota Status
Accessories I (Redesign)	2	Widely used	1-2 %	Air conditioners in all vehicles are two stage; power steering assist is variable
Two speed accessory drive	2	Used only in one or two models		
P-Metric Radial Tires	3 (over bias-ply)	Widely used	N/A	Used in 100% of passenger cars
Liquid Injection Molded Tires	4 (over bias-ply)	Post-1995 technology	?	-
Body Design Technology				
Material Substitution I (HSLA, Unit body)	6.6 (for 10% weight reduction w/ drive-train optimization)	Widely used	N/A	Used in 100% of passenger cars
Material Substitution II (High HSLA, plastics)	6.6 (for 10% weight reduction w/ drive-train optimization)	Feasible but not utilized currently due to low fuel prices	1-2 %	Weight reduction is very difficult
Material Substitution III (aluminum, carbon fiber, composites)	6.6 (for 10% weight reduction w/ drive-train optimization)	Post-1995 technologies		

* Percentages based on sales data.

Technology	EEA estimate Fuel Economy (Percent Gain)	EEA Status	Toyota's estimated Fuel Economy (Percent Gain)	Toyota Status
Aerodynamics I	3.4 (for 15 percent drag reduction)	Already occurred in 1978-1985	N/A	Used in 100% of passenger cars
Aerodynamics II	3.4 (for 15 percent drag reduction)	Currently being incorporated into new designs	1-2 %	There are practical limits
Aerodynamics III	3.4 (for 15 percent drag reduction)	Advanced levels that can be attained in the 1990's	1-2 %	Design practicability problems

* Percentages based on sales data.

FIGURE III

SPECIFICATIONS OF

AXV AND TERCEL EZ ('89 MY)

	TERCEL ('89 MY)*	AXV
Length (inch)	157.3	148.2
Width (inch)	64.0	64.6
Height (inch)	52.6	53.5
Wheelbase (inch)	93.7	92.1
Tread/Front (inch)	54.5	56.1
Tread/Rear (inch)	54.3	54.1
Engine Displacement (cc)	1,456	1,084
Engine Type	Gasoline 4-cycle, L4	DI Turbo Diesel L3
Curb Weight (lbs.)	2,000	1,433 (Target)
Interior Volume Index (cu ft)	92	Approx. same
Transmission Type	M4	CVT
Fuel Economy (mpg)	City : 39 HWY : 53 Combined : 44	Japan 10 mode : 80 37 mph constant : 127 (60 Km/h)

NOTE: * : EL31L-NGKBSA

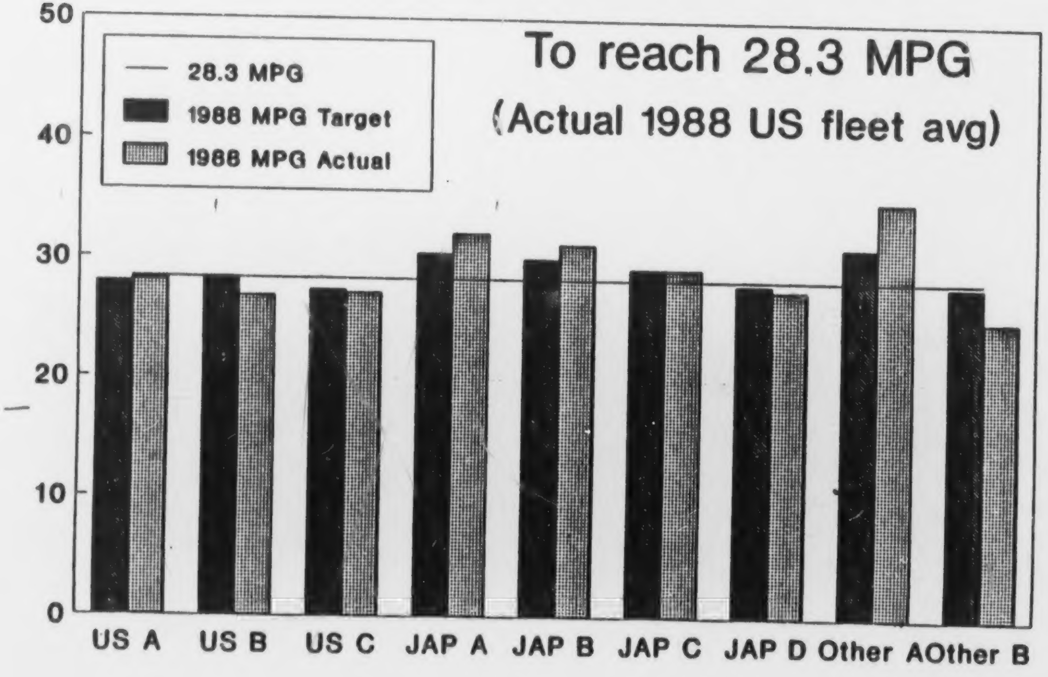
FIGURE IV

THE IMPRACTICALITY OF THE AXV'S FUEL ECONOMY IMPROVEMENT TECHNOLOGY FOR PRODUCTION VEHICLES

Technology	Reasons Why
Direct Injection Diesel Engine	1. Noncompliance with NOx and particulate emission standard 2. Noise level above engineering standards 3. Low market demand for diesel powered vehicles 4. Engine vibration level above engineering standards
CVT (Continuously Variable Transmission)	1. Need of improving the belt durability 2. Low torque sufficient only for small vehicles
Lightweight Materials Resin...Body Panels, Windows FRP*....Suspension, Steering, Chassis Components Aluminum...Engine Block *Fiber Reinforced Plastics	1. Large cost increases 2. Insufficient long-term durability
Streamlined Styling	1. Incompatible with space utility and styling design 2. Difficult to assure cooling performance

FIGURE V

Size Class Weighted Fuel Economy
Actuals vs Targets, 1988



SOURCE: OFFICE OF TECHNOLOGY ASSESSMENT, BASED ON OAK RIDGE DATA

STATEMENT OF HONDA MOTOR CO., LTD.
ON AUTOMOBILE FUEL EFFICIENCY STANDARDS
FOR THE CONSUMER SUBCOMMITTEE
SENATE COMMERCE, SCIENCE AND TRANSPORTATION COMMITTEE

May 22, 1989

Honda appreciates the opportunity to present its views on the Corporate Average Fuel Economy (CAFE) program as it relates to the larger issue of global warming.

Honda has grown from an importer of small cars and motorcycles in the 1970s to become the fourth largest automobile producer in the U.S. During that time, Honda has demonstrated its capability to produce cars that achieve high levels of fuel economy. Automobile fuel economy improvements have taken place despite changes in emission and safety standards and consumer preferences for air conditioning, power accessories, and more powerful engines.

In 1979, the minicompact three-door Honda Civic with a 1.5 liter engine had a fuel economy rating of 30-38 mpg. The 1979 three-door Honda Accord, rated as a subcompact, achieved a fuel economy rating of 26-29 mpg. Today these vehicles achieve higher levels of fuel economy despite their increase in size and weight. In 1989, the basic three-door Civic with four-speed manual transmission has a combined fuel economy average of 42 mpg. The four-door Civic, now the same size as the 1979 Accord, has a rating of 34-39 mpg. The 1989 Accord has a fuel economy average rating of 28-35 mpg.[1]

During the 1980s, the U.S. marketplace has changed. There are new entrants in both the low and high end. Honda, like other vehicle manufacturers, must offer a broader range of products to remain competitive. Gasoline prices have not increased as projected and consumer demand has shifted towards larger and more performance oriented vehicles.

Some suggest that the technology already exists to increase the fleet CAFE up to 35 mpg by 1995/2000. But not every technology is applicable across the board. Further, there are tradeoffs between fuel economy, vehicle emissions and safety. The vehicle must be regarded as a total system so that rules do not work at cross purposes.

Although each manufacturer is developing new technologies to improve fuel economy, only some of them can be successfully introduced into the market. The product mix of a manufacturer is largely market driven and not necessarily controlled by the technical features of a

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1. Combined fuel economy calculated before applying adjustment factors (city 0.9, highway 0.78). Range depends upon transmission type.

product. For example, the diesel engine was viewed as one of the "magic bullets" in the late 1970s and early 1980s because it was applicable to both small and large engines.It was rejected by the American consumer because of sluggish performance, cold start problems, noise and particulate emissions. Manual transmissions increase fuel efficiency, but many Americans do not want to drive a car with a manual transmission.

Some new attractive technologies are still under study. Lighter materials such as aluminum, plastics and composites are being used on a limited scale in new vehicles to improve fuel economy and upgrade or maintain performance. However, the benefit of such materials has to be evaluated over a reasonable period against such factors as durability, accident damage, ease of repair, recycling and lifetime cost. There is discussion regarding increasing the number of valves per cylinder to four. Some say this will increase fuel efficiency, others say performance. In combination with other factors, such changes can do both but are not a panacea.

Alternative fuels have been regarded as a way to reduce dependency on imported oil while reducing air pollution. However, problems remain to be resolved such as the availability of fuel, durability of materials, unregulated emissions and the establishment of an infrastructure. Furthermore, the creation of methanol from coal or natural gas uses more energy in the conversion process than it saves in the replacement of gasoline. Additionally, since it contains less carbon than gasoline, it is a less efficient fuel.

With respect to the reduction of fossil fuel usage, we believe a carbon fee or gasoline tax might be the best approach. However, we are not certain how the general public will respond to this increased cost of living in order to satisfy environmental and energy concerns.

Adjustments to CAFE are just one way to address the issue of energy conservation and global warming. There are other public policy questions that go beyond fuel efficiency. For example, is there a way to reduce vehicle miles travelled absent the commitment of the American public to lifestyle changes?

Specific changes to the existing CAFE program have been proposed. Honda strongly objects to any proposal that would set different CAFE levels for individual manufacturers based on a percentage increase of their CAFE from a base year. This approach punishes companies who have achieved high fuel economy and it rewards those companies with a low CAFE. It also restricts healthy competition because it would virtually fix the current product mix. This proposal would result in the bulk of the U.S. fleet meeting much lower standards and conserving less fuel.

Possible alternatives to increasing CAFE standards should address market incentives as well as technological possibilities. We suggest the following:

1) Fuel economy performance targets should be set based on a vehicle's inertial weight class, so that technological progress can be evaluated separately from product mix considerations.
2) Maximum flexibility should be built into such a policy so that manufacturers can choose various technologies and respond to changing market situations.
3) Some form of market incentive should be provided by means other than fuel economy standards in order to encourage the general public to purchase fuel efficient automobiles.
4) Technological feasibility and cost/benefit analysis should be considered in setting any new standard.
5) Any new CAFE standard should provide adequate lead time for manufacturers.
6) NHTSA should retain limited authority to adjust the standards downward should they prove unachievable in a given year due to unforeseen events.

Thank you for considering our views.

NISSAN'S PERSPECTIVE ON GLOBAL WARMING, REDUCTION OF GREENHOUSE GASES, AND MOTOR VEHICLE FUEL ECONOMY

I. INTRODUCTION

Nissan appreciates the Committee's interest in Nissan's perspective on fuel economy, and we are pleased to provide our comments on fuel economy policy issues. For the U.S. market, Nissan manufactures mainly small vehicles (passenger cars and light trucks) in Japan and in the United States. Our U.S. manufacturing facility, in Smyrna, Tennessee, represents a past capital investment of $1.1 billion and annual vehicle production of 120,000 per year. Nissan has recently announced plans to increase production to 440,000 vehicles per year and invest another $1.2 billion in that facility.

We at Nissan would like to do our part in contributing to the dialogue and in identifying fair and meaningful measures which address the Congress' concerns about global warming and energy conservation. We recognize the responsibility of the auto industry to cooperate in taking constructive actions which deal with the "greenhouse effect" that is so much on the minds of the American public these days.

Nissan has always made a conscious effort to provide useful information to U.S. governmental bodies with respect to fuel economy. For example, in April, 1988, we were the only Japanese manufacturer to respond to the National Highway Traffic Safety Administration's (NHTSA's) request to provide data on the projected fuel economy of our fleet in 1989 and 1990. We also sent a technical expert from Japan to participate in an Office of Technology Assessment (OTA) workshop in September, 1988 on the potential for further improvements in fuel economy.

As debate over the appropriate government role in influencing fuel economy has intensified, some have attempted to claim that those manufacturers above the current Corporate Average Fuel Economy (CAFE) standard have had an "easy ride" and have avoided making improvements in fuel economy. This is erroneous. Nissan is proud of its record of accomplishments and continued efforts

to develop technologies to improve economy. We have a history of extensive research and development in these areas.

We hope our input can be of some value to the Subcommittee.

II. GLOBAL WARMING IN PERSPECTIVE

A. Greenhouse Gases and Motor Vehicles

The basic greenhouse gases associated with motor vehicles are carbon dioxide (CO_2) and Chlorofluorocarbons (CFC's). CO_2 gas and H_2O are the byproducts of the gasoline combustion process. There is a wide body of data on the amount of CO_2 attributable to the U.S. motor vehicle fleet (23%, according to 1985 DOE data.). General scientific agreement also exists on the following points:

1. In terms of relative concentration of greenhouse gases, CO_2 is present in the lower atmosphere at the highest concentration.

2. CFC's are present at the lowest concentration, but their rate of annual increase is the highest among all greenhouse gases. On a per-molecule basis, CFC's contribute significantly more to the global warming effect (on the magnitude of 20,000 times more, according to EPA's draft report, Policy Options for Stabilizing Global Climate Change).

Mobile air conditioners are the single largest source of CFC's (26.6%, according to EPA 1985 data). Nissan recognizes that the most meaningful effort the auto manufacturers can take is to aggressively work to reduce CFC's. In this regard, (1) Nissan supports the phaseout of CFC's; and (2) we are making efforts to reduce the amount of CFC's emitted in the use and servicing of mobile air conditioners on the road.

The Society of Automotive Engineers (SAE) and the Mobile Air Conditioning Society (MACS) have been cooperating with EPA in developing a recycling standard for auto air conditioning CFC's. Nissan was the first Japanese manufacturer to accept the voluntary recycling standard. Additionally, our engineers are working to reduce leakage in current air conditioner systems by improving the seals and hoses of those systems.

B. Global Problems Require Global Solutions

Nissan recognizes the global nature of the "greenhouse" phenomena. We think the best solutions to deal with this issue will be those that are global in nature. Our intent in raising this point is not to attempt a de minimis argument about the role of motor vehicles sold in the U.S. with regard to greenhouse gases. We recognize that no aspect of this problem is trivial if the potential impacts are as great as have been suggested. Rather, the intention is to point out that in the absence of global initiatives, unilateral actions by the U.S. are simply not realistic ways to address the theoretical global warming trend. Tangible results will not be achievable without coordinated global efforts. We would urge the U.S. government not to lose sight of this fact.

III. IS CAFE EFFECTIVE FOR REDUCING CO2 EMISSIONS FROM AUTOMOBILES?

Recent debate about global warming policy responses in Congress have focused on the Corporate Average Fuel Economy (CAFE) standard as a means to achieve reduced CO_2 from motor vehicles. Yet there are two key factors which affect overall fuel consumption (and associated CO_2 emissions) but are not controllable by a CAFE standard. Those are marketplace demands, and vehicle miles travelled (VMT).

A. THE EFFECT OF MARKETPLACE DEMANDS

By definition, CAFE is a sales-weighted value. Yet a manufacturer's sales mix is for the most part determined by external factors beyond the control of the automobile manufacturer, such as fuel prices (which can be influenced by government policy), and customer preference (market demand for size, performance, luxury styling, options such as automatic transmission and air conditioning and so on).

The continued availability of relatively cheap gasoline has prompted customers to favor performance over fuel economy in new vehicles in recent years. Manufacturers have no control over these market conditions. CAFE has not been effective in shifting customer preference towards fuel-efficient vehicles; policies which succeed in influencing customer demand will be much more effective as a means to reduce total CO_2.

B. THE EFFECT OF VMT

Even with a greater proportion of fuel-efficient vehicles on the road, increases in VMT will tend to offset any potential fuel-savings and CO_2 reductions. Most current projections for increases in VMT are on the average of 2 to 4% annually. Thus to achieve no increase in CO_2 aggregate emissions from motor vehicles over time, increases in fuel economy would have to be dramatic just to counteract rising VMT. On the other hand, reduced VMT could serve to reduce CO_2 even if there are no changes in the fuel economy of vehicles currently on the road.

C. THE EFFECT OF OLDER VEHICLES

Also, additional CAFE requirements would only apply to new vehicles. There would be no fuel-conserving effect for in-use vehicles, which are greater in number than new vehicles and contribute relatively more CO_2 to the atmosphere. Greater gains can be accomplished if government policy is directed towards encouraging the replacement of older, less fuel-efficient vehicles. New vehicles comprised only about 7% of the total motor vehicle fleet in 1987, the latest year for which there is available data.

Total Automobiles Registered in USA in 1987:	137,323,632
New Vehicles Registered in 1987:	10,122,154

(Data source: Federal Highway Administration and Motor Vehicle Manufacturer's Assn.)

Moreover, an overly stringent CAFE would also defer some purchases of newer, more fuel efficient vehicles, if the cost of new vehicles is increased beyond the perceived value of the increased fuel economy.

D. THE EFFECT OF OTHER MOTOR VEHICLE REGULATIONS

DOT by law is required to consider the effect of other motor vehicle regulations on fuel economy when setting CAFE standards, because the associated weight and technology tradeoffs do serve to exert downward pressure on achievable fuel economy.

Below is a description of the weight or fuel economy effects of some major new regulations which are in place or being discussed for future vehicles. The combined effect of these safety and emission control measures would be a 1.6 - 3.3% reduction in fuel economy in Nissan vehicles. In other words, even if our technology remains unchanged, these other regulatory requirements will have the effect of reducing our CAFE.

1. Safety

Side Impact:
Although establishment of a dynamic side impact test requirement has not yet been finalized, we estimate that the effect of a final requirement will be 9-13 pounds added weight to new passenger cars.

Passive Restraints:
The passive restraint requirement already in effect for passenger cars has added 22-44 pounds of weight to new passenger cars.

2. Emission Control

0.4 gpm NOx (scheduled to take effect in 100% of the new-car fleet in California in 1994):
There is no weight penalty associated with a more stringent standard for tailpipe NOx emissions, nor is there any effect on fuel economy of the required improvement to the catalyst system, but the effect of necessary adjustments to the air-fuel ratio, exhaust gas recirculation (EGR) and ignition timing to reduce engine-out NOx emissions is a 1-2% decrease in fuel economy.

Onboard Refueling Vapor Recovery:
The onboard refueling canisters being contemplated by EPA would add 13 - 22 pounds of weight to new passenger cars.

It is reasonable to bear in mind the effects of these other regulations when judging achievable fuel economy improvements.

IV. FACTORS WHICH WILL AFFECT MARKETPLACE DEMAND AND VMT

CAFE has not succeeded in shifting consumer demand towards more fuel-efficient vehicles; neither has it been effective in controlling VMT, which has in fact increased over the years that CAFE has been in effect. We see two alternatives which will influence demand and VMT factors in the real world, and thus bring about CO_2 reductions :

A. A "carbon fee" offers some advantages over a CAFE standard and deserves to be studied for the following reasons.

1. It would apply over other fossil-fuel based sectors, which would also translate into more real-world CO_2 reductions.
2. It would tend to encourage customers to demand more fuel-efficient vehicles.

B. Consumer incentives (such as a tax rebate) for the purchase of high-mileage vehicles, as well as disincentives (such as surcharges or increased registration fees) for purchasing or retaining low-mileage vehicles, also deserve further study. Several of the legislative proposals to address global warming also suggest this concept.

V. CAFE-BASED ALTERNATIVES

Nissan has never opposed CAFE or fought for its repeal. Yet we recognize that CAFE has been limited in its ability to be effective energy policy or beneficial to the American consumer. But we are aware that Congress may overlook caveats about the ability of CAFE to bring about reductions in CO_2, and attempt solutions through CAFE. In view of this, Nissan would like to address some of the suggestions currently before the Committee about how to improve CAFE.

A. Manufacturer-Specific Percentage Improvement

Several of the pending bills which address CAFE suggest an equal percentage improvement over some (1988 or 1989) baseline CAFE be required of all manufacturers. We think this approach is neither fair nor warranted for the following reasons:

a) Nissan has made significant efforts to incorporate advanced technologies to bring about fuel economy improvements. Please refer to Attachment 1, which shows the degree to which Nissan has already adopted fuel-efficient technologies in our new cars. The record contradicts the assertions by others that high-mileage manufacturers have not done their part to improve fuel economy.

b) A manufacturer-specific percentage improvement requirement would be unfair to high-mileage manufacturers such as Nissan, because technical difficulty and cost increase as the level of targeted fuel economy increases. For example, a 65 percent improvement over Nissan's 1988 base year CAFE of 30.4 mpg would require a target of 50.16 mpg. A manufacturer whose 1988 CAFE is 26 mpg would have a target of 42.9 mpg. Nissan has already incorporated most of the significant, available fuel economy technologies, so our remaining options for further fuel economy improvements would be:

1) downsizing, or
2) incorporating unproven and potentially very costly technology.

Since Nissan's fleet is mostly small size cars, further downsizing will likely result in vehicles that will fall short of the space and comfort needs of U.S. car buyers. In other words, Nissan's only option is unproven and costly new technology.

In contrast, the low mileage manufacturers will have three options:

1) Incorporating the technology already in use in Nissan vehicles;
2) downsizing; and, if necessary,
3) incorporating unproven and potentially very costly technology.

Since low mileage manufacturers have more large cars in their fleets, downsizing will not likely result in unacceptable small vehicles. They can also adopt the technologies already used by Nissan.

Under the manufacturer-specific percentage improvement CAFE, then, Nissan and other high-mileage manufacturers will have to produce vehicles that will be very expensive or unacceptably small because of fuel economy requirements. Consumers will not want to buy these cars because they will have the option of buying larger, less expensive models. Low-mileage manufacturers will not face this same disadvantage under this CAFE approach.. We therefore strongly disagree that this is indeed the fairer approach, as some have suggested.

c) Nissan is also unaware of any legislative or regulatory precedent for requiring manufacturer-specific standards. We question whether such a precedent is warranted if there are other means to achieve the same goals.

B. Average Fuel Economy by Model or Weight Class

At the May 2 hearing on Fuel Economy, OTA suggested an alternative approach to CAFE, using EPA-designated size classes to establish size-class specific fuel economy requirements. On its face, we think this approach is more fair than a manufacturer-specific percentage-improvement, because it would preserve sales mix flexibility for all manufacturers, and would provide regulatory incentive for fuel economy improvements. However, the OTA approach was not clearly described (for example, how would new entrants to a size class be treated?) Nevertheless, we would urge the Committee to carefully evaluate OTA's proposal. Nissan is now doing the same.

VI. OTHER ISSUES

A. THE ANTI-BACKSLIDING PROPOSAL IS MARKET RESTRICTIVE AND UNNECESSARY

The "anti-backsliding" proposal suggested by Senator Metzenbaum unfairly penalizes high-mileage manufacturers for responding to market demand. We also believe that as long as the target value set by Congress is met by the manufacturer, additional penalties are unwarranted. Moreover, as discussed earlier, other regulatory requirements beyond the manufacturer's control can result in falling CAFE. A prohibition against backsliding should only be imposed for those who fail to meet the standard.

VII. CONCLUSION

In conclusion, Nissan believes:

1. **Phaseout of CFC's by Nissan and other auto manufacturers will produce the most meaningful effects on global warming.**

2. **True solutions to global warming must be developed on a global basis.**

3. **Policies which influence marketplace demand will be much more effective in realizing CO_2 reductions than will CAFE-based standards.**

4. **Any required improvement in fuel economy should be fair.**
   - o **A manufacturer-specific percentage improvement requirement unfairly disadvantages high-mileage manufacturers who have in fact made great efforts to improve fuel economy.**
   - o **A standard which does not restrict market niches to any manufacturer is also more equitable.**

5. **The approach suggested by OTA, based on size-class, or some variation of this approach, appears to be the fairest of the alternatives before Congress and deserves further study.**

Attachment 1: FUEL ECONOMY IMPROVEMENT TECHNOLOGIES BY NISSAN

TECHNOLOGY TO IMPROVE FUEL ECONOMY	% PENETRATION			
	'87MY MARKET (OTA)	'87MY NISSAN	'88MY NISSAN	'89 MY NISSAN
Front-wheel Drive	78.0	91.1	91.3	81.0
4-cylinder/4-valve	5.0	2.2	3.7	72.0[*1]
Four-speed Automatic[*2] [Automatic Transmission market share]	35.0 (40.1) [87.3[*3]]	32.2 (59.1) [54.5]	23.6 (46.3) [50.9]	30 (57.3) [52.4]
Electronic Transmission Control	2.0	3.8	4.4	25.0
Aerodynamics (Cd from 0.37 to 0.32) --(Average Cd)	N/A	N/A (0.36)	N/A (0.36)	N/A (0.35)
Tires	N/A	N/A	N/A	N/A
Accessories	N/A	N/A	N/A	N/A
Engine Improvements:				
-Overhead Cam Engines	40.0	100.0	100.0	100.0
-Roller Cams	40.0	0.0	0.0	0.0
-Low Friction Rings/Pistons	N/A	N/A	N/A	N/A
Non-carbureted:	76.0	59.7	99.4	100
-Throttle Body Fuel Injection (TBI)	31.0	12.3	63.9	54.0
-Multipoint Fuel Injection (MPI)	45.0	45.0	35.5	46.0[*4]

NOTES:

[*1] Includes 3-valve engines
[2] Figures in parentheses shows 4-speed penetration within A/T class
[3] This figure is MVMA, not OTA, data
[4] In '91MY, Multipoint Fuel Injection will reach 100% penetration

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COMMENTS OF THE AUTOMOBILE IMPORTERS OF AMERICA, INC. ON FUEL ECONOMY ISSUES RELATING TO GLOBAL WARMING SUBMITTED TO THE CONSUMER SUBCOMMITTEE OF THE SENATE COMMERCE, SCIENCE AND TRANSPORTATION COMMITTEE

AIA is a non-profit trade association that represents U.S. importers of passenger cars and light trucks.[1] We welcome the opportunity to provide comments on behalf of our members on the issue of fuel economy as it relates to concerns about global warming. AIA represents a broad spectrum of manufacturers whose CAFE achievements range from significantly above the 27.5 mpg standard to well below it.

We understand the concerns of the Congress over global warming and the need to take measures to address these concerns. However, we think there are a few important points to remember. First, global warming is just that, global, and solutions must address not only activity in the U.S., but in all countries of the world. Second, it is imperative that we set realistic objectives and assure ourselves that any proposed action will help reach those objectives. Third, these actions must be part of a comprehensive, long-term plan that provides adequate leadtime to allow the affected industries to achieve objectives without severely disrupting their operations. Finally, any requirements that are imposed on our society must be fair, rational, and effective.

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[1] AIA's members include: BMW of North America, Inc.; American Honda Motor Company, Inc.; Hyundai Motor America, Inc.; Isuzu Motors of America, Inc.; Jaguar Cars, Inc.; Maserati Automobiles, Inc.; Mazda Motors of America, Inc.; Mitsubishi Motor America, Inc.; Nissan Motor Corporation U.S.A; Peugeot Motors of America, Inc.; Porsche Cars North America, Inc.; Rolls-Royce Motor Cars, Inc.; Rover Group USA, Inc.; Saab-Scania of America, Inc.; Subaru of America, Inc.; American Suzuki Motor Corporation; Toyota Motor Sales U.S.A., Inc.; Volkswagen of America, Inc.; and Volvo North America Corporation.

We are not advocating a no action or wait and see attitude, rather we are suggesting that steps to deal with global warming be carefully and comprehensively planned so that the right decisions are made. Precipitous decisions to take drastic actions without careful planning will not solve the problem and, indeed, could make the ultimate solution more difficult to achieve.

Simply increasing CAFE is a non, if not counter productive, response to the problem. It focuses on a narrow segment of the problem -- namely, the U.S. motor vehicle industry (in fact, only new vehicles). It does not address the real source of the motor vehicle transportation sector's use of fossil fuel -- namely, the miles a vehicle travels in a year. Nor is just increasing CAFE a comprehensive, national approach or the ultimately necessary global strategy.

A review of the relative impact of the various sources of global warming gases indicates that CFCs, if controlled, could result in a 17 percent reduction in global warming gases. Deforestation has been responsible for a 25 percent share of CO_2 formations from anthropogenic sources. Coal burning electric power plants could be completely replaced over time with hydro-electric or nuclear power plants. Other alternative energy sources need to be considered as well.

According to EPA's draft report on global warming[2], CFCs contribute 17 percent to global warming and transportation energy use 20 percent. Of that 20 percent, only a small fraction (less than one percent) would be reduced by CAFE increases since it would affect only new light-duty vehicles (not existing vehicles, trucks, trains, and other transportation sources) and the reduction for new vehicles would only be incremental over the current levels of fuel consumption.

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[2] Policy Options for Stabilizing Global Climate, Draft Report to Congress, U.S. Environmental Protection Agency, Office of Policy, Planning, and Evaluation, February 1989.

Movement to replace CFCs and recycle them where replacements cannot be used immediately is well underway. This is an extremely important action since each additional CFC molecule has a global warming impact 20,000 times greater than an equal amount of CO_2.[3] The motor vehicle industry strongly supports both the replacement and recycling efforts and is working with the supplier industry to develop substitutes. In fact, in discussing the importance of a CFC phase-out, the Natural Resources Defense Council (NRDC) has stated:

> For example, a 1995 phase-out would have more effect than doubling the efficiency of all transportation systems globally by 2000.[4]

Attention also needs to be paid to the other 63 percent the of sources responsible for global warming highlighted in the EPA report. This includes industrial, residential, and commercial energy use, forestry, and agriculture. The large portion of the 20 percent attributable to transportation energy use that is due to the existing fleet of vehicles also needs to be addressed.

Even if one does focus on CAFE, it is important to realize that manufacturers cannot control consumer choice. It is the public that decides what level of fuel economy is important to them. There are many high-mileage cars offered today in the U.S. -- several with fuel economy ratings above 45 mpg -- but consumers are not buying these cars in significant numbers, and manufacturers cannot force their sale on an unwilling public. Nor can manufacturers control the number of miles the public drives their vehicles each year. Yet, increased VMT and general economic growth are greatly more important in affecting the level of fuel consumption than are tighter CAFE standards. Another step that should be considered is the removal of older, less efficient vehicles from the fleet.

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[3] Ibid.

[4] Testimony of the Natural Resources Defense Council before the Senate Subcommittee on Environmental Protection, Committee on Environment and Public Works, May 19, 1989.

CAFE does not answer the global warming problem because there is no reasonable CAFE level at which there can be an assurance of a significant decrease in motor vehicle fuel consumption. What Congress should strive for is actions that will, in fact, reduce consumption of fuel and reduce VMT. One way to do this would be to impose a carbon fee that would affect all carbon-based fuels. This fee would affect the entire in-use vehicle fleet (in excess of 100,000,000 vehicles), not just the new vehicles that would be affected by tighter CAFE standards. This fee would have to be significant enough to raise the importance of fuel conservation in the minds of consumers and, therefore, affect their consumption decisions.

The current motor vehicle fleet has a rich diversity of vehicle types and sizes to serve the wants and needs of the American public. While some small improvement in the new car fleet average fuel economy (i.e., the average of the entire new car fleet, not individual manufacturer CAFE levels) is possible through the use of technology, as suggested by OTA, many of the proposals put forth suggest step function changes in the new motor vehicle fleet fuel economy which would seriously alter the make-up of the new motor vehicle fleet. Many of AIA's members are single-line manufacturers and would face a total disruption in their market niche.

Nor are "high-mileage prototypes" the answer. There has been a lot of discussion in the press and in Congress about how easy it is to improve the mileage of the fleet by alluding to the existence of these high-mileage vehicles. This is an erroneous assumption. A production vehicle must balance an enormous number of conflicting attributes to provide a vehicle acceptable to the customer.

All of these concept vehicles that have been mentioned were built at a time of fuel shortages as an example of what can be built. But, their design focused on one narrow attribute -- in this case fuel economy. These vehicles do not have the right blend of design characteristics that would make them marketable today.

For example, the Volvo LCP 2000 which has been touted as a 4-seater is in fact a 2-seater (the 2 rearward facing seats in the luggage area eliminate any cargo space). In addition, this vehicle is powered by a small diesel engine, like most of the other "fuel economy prototypes." Diesel engines just do not sell in the U.S. in any substantial amount for the passenger car market. Moreover, proposed amendments to the Clean Air Act would set NO_x emission limits so low as to make diesel engines technologically infeasible. Another example is the VW E80. It is also a small diesel and incorporates start/stop technology, which causes the engine to shut off when the vehicle stops and restart when the accelerator is pressed -- likely not sales worthy in any but the most severe fuel price/availability scenarios. The 0-60 miles per hour (mph) acceleration time for this vehicle is 26.5 seconds. Currently, a "slow" car in today's market accelerates to 60 mph in about 13 seconds.

Faced with the fact of only being able to purchase subcompact-sized cars and with fuel prices still low, many consumers would continue to keep older, less efficient vehicles. This would clearly be in conflict with the desire to reduce motor vehicle fuel consumption. In fact, elimination of larger cars would be a disincentive for carpooling due to the lack of interior volume and comfort of smaller vehicles. Four or five passengers in a large car is far more "fuel efficient" than four or five individuals driving small, high-mileage vehicles.

With this as a background, some of the specific issues raised at the recent hearing are addressed below.

A percentage increase in CAFE for each manufacturer

This strategy would require all manufacturers to improve the mileage of their own fleet (based on 1988 or 1989 baselines) by a uniform percentage. This would penalize manufacturers who have achieved or maintained a high fleet average. It would let those whose fleet average is the lowest improve the least. Clearly this strategy would not be fair or equitable. It also would probably violate international trade agreements (GATT) because it effectively requires most imported car fleets to meet a more stringent standard than domestic cars.

Under this concept, a manufacturer with a high CAFE would be penalized for its past extra efforts and would not only have to increase the fuel economy of its fleet more, numerically, than one whose CAFE level was lower (i.e., 10% of 20 versus 10% of 30), but these gains would also be more difficult to achieve. Improving mileage from 35 to 40 mpg is much more difficult than improving from 28 to 33 mpg.

Changes in the penalties for failure to comply

The current unlawful conduct provision for failure to meet CAFE or other requirement should be eliminated. Likewise, there should be no provision that would ban the sale of vehicles for not achieving the required levels. The only penalty should be a monetary civil penalty.

Impact of other standards

Any plan for higher fuel economy must take into account future safety and emission standards and other requirements that would have a negative impact on the ability of vehicles to achieve higher miles per gallon. Two brief examples include the possible imposition of new tailpipe standards (0.25 grams per mile (gpm) non-methane hydrocarbons and 0.4 gpm oxides of nitrogen) and side impact requirements for vehicle safety. The diesel automobile, which provides significantly better fuel economy than its gasoline counterpart, cannot meet a NO_x standard much below 1.0 gpm. In addition, tomorrow's air conditioning system, due to the phase-out of CFCs, will be less efficient and result in some decrease in fuel economy.

Anti-backsliding provision

We are opposed to any such provision. As stated above, consumer choice drives what vehicle types are produced and sold. If economic forces beyond the control of manufacturers cause consumers to base purchase decisions on other factors than fuel economy, manufacturers should not be penalized for changes in the marketplace. Such a provision would also hinder manufacturers' ability to produce new models in response to market demands.

Conclusion

In summary, then, we note the following:

- Global warming must be addressed in the broadest sense and not just focus on the motor vehicle industry.

- Tighter CAFE standards simply will not achieve the goal of reduced fuel consumption since they have no impact on the consumer.

- To reduce overall fuel consumption, the focus should be on higher fuel prices, VMT reductions, and the replacement of older vehicles.

- If some form of government mandated requirement for improved fuel economy is implemented, it must be carefully considered in terms of its impact on all manufacturers.

POST-HEARING QUESTIONS FOR
AUTOMOBILE MANUFACTURERS'

STATEMENT OF SENATOR BRYAN TO HELEN PETRAUSKAS, FORD MOTOR CO. [1/]

1. AT THE HEARING YOUR WITNESSES WERE SHOWN A CHART CONTAINING DATA FROM THE WORLD RESOURCES INSTITUTE ABOUT THE RELATIVE CONTRIBUTION OF U.S. GASOLINE USE TO WORLDWIDE CARBON DIOXIDE EMISSIONS. THAT DATA INDICATED THAT U.S. CARBON DIOXIDE EMISSIONS FROM GASOLINE ALONE ARE HIGHER THAN CARBON DIOXIDE EMISSIONS FROM ALL SOURCES IN EACH OF THE FOLLOWING AREAS OF THE WORLD: JAPAN, THE MIDDLE EAST, WEST GERMANY, UNITED KINGDOM, LATIN AMERICA, SOUTH AND SOUTH EAST ASIA, AFRICA AND FRANCE. DO YOU AGREE THAT THIS DATA IS ACCURATE? IF NOT, PLEASE STATE SPECIFICALLY IN WHAT WAY IT IS INACCURATE, AND STATE WHAT YOU BELIEVE TO BE ACCURATE DATA ON THIS POINT.

2. THE AUTOMOBILE MARKET IS INCREASINGLY A WORLDWIDE MARKET, FOR BOTH U.S. AND FOREIGN MANUFACTURERS. PLEASE STATE WHETHER YOUR COMPANY SELLS VEHICLES OVERSEAS, AND, IF SO, THE EXTENT OF YOUR CURRENT SALES AND THE TREND YOU PROJECT IN SUCH SALES FOR THE FUTURE.

[1/] The questions were sent by letter of May 23, 1989, and at time of going to press, August 2, 1989 no responses had been received by the Committee.

3. IS THE AUTOMOBILE MARKET AN EXPANDING ONE ON A WORLDWIDE BASIS? DO YOU FORESEE INCREASED VEHICLE PURCHASES AND MILES TRAVELED FOR EITHER THE U.S. OR THE FOREIGN CONSUMER?

4. PLEASE LIST ALL VEHICLE MODELS THAT YOU MANUFACTURE OVERSEAS, AND ALL VEHICLE MODELS THAT ARE PRODUCED THROUGH JOINT VENTURES BETWEEN YOUR COMPANY AND FOREIGN COMPANIES. PLEASE STATE THE VOLUME OF EACH MODEL THAT IS PRODUCED EITHER OVERSEAS OR THROUGH JOINT VENTURES, AND THE LOCATION OF THE MANUFACTURING PLANTS FOR EACH MODEL. INCLUDE IN YOUR ANSWER INFORMATION ON MODEL YEARS 1989, 1990, AND PROJECTED INFORMATION THROUGH 1995 IF AVAILABLE.

5. PLEASE STATE, FOR MODEL YEARS 1978 TO THE PRESENT, THE PERCENTAGE OF YOUR SALES THAT ARE ATTRIBUTABLE TO VEHICLES MANUFACTURED OVERSEAS. WHAT PERCENTAGE OF SALES FROM MODEL YEARS 1978 TO THE PRESENT ARE VEHICLES MANUFACTURED AS JOINT VENTURES WITH FOREIGN COMPANIES?

6. YOU HAVE STATED IN YOUR TESTIMONY THAT FUEL ECONOMY IS A LOW PRIORITY FOR NEW CAR BUYERS, CITING THE J.D. POWERS 1988 SURVEY, WHICH FOUND THAT ONLY 3% OF BUYERS LISTED FUEL ECONOMY AS THE MOST IMPORTANT FEATURE IN BUYING A CAR. YET OTHER RECENT SURVEYS INDICATE THAT AMERICANS ARE INCREASINGLY CONCERNED ABOUT THE ENVIRONMENT, AND ARE WILLING TO PAY FOR ENVIRONMENTAL PROTECTION. FOR EXAMPLE, AN APRIL, 1989, ANALYSIS WRITTEN BY LOU HARRIS AND OTHERS FOUND THAT A MAJORITY OF AMERICANS BELIEVE THIS

COUNTRY NEEDS TOUGHER LAWS TO PROTECT THE ENVIRONMENT, AND THAT MORE MONEY SHOULD BE SPENT TO DO SO, EVEN IF IT MEANS RAISING TAXES. ADDITIONALLY, AN OCTOBER 1988 OPINION POLL CONDUCTED FOR THE COMMUNICATIONS CONSORTIUM FOUND THAT 77% OF THOSE POLLED FAVOR RAISING FUEL ECONOMY STANDARDS, EVEN IF IT ADDS $500 TO THE PRICE OF A CAR. HOW DO YOU SQUARE THOSE RESULTS?

7. PLEASE PROVIDE ANY CONSUMER OR MARKETING SURVEYS OR ANALYSES PERFORMED BY OR FOR YOUR COMPANY TO ASCERTAIN CONSUMER PREFERENCE WITH RESPECT TO VEHICLE SIZE, OR TO DETERMINE THE EFFECTIVENESS OF EMPHASIZING ENVIRONMENTAL ISSUES OR FUEL EFFICIENCY IN SALES EFFORTS WITHIN THE LAST 10 YEARS. PLEASE STATE WHETHER ANY OF YOUR ADVERTISING EFFORTS SINCE 1980 HAVE EMPHASIZED FUEL EFFICIENCY OR OTHER ENVIRONMENTAL BENEFITS OF YOUR VEHICLES. IF SO, PLEASE PROVIDE EXAMPLES OF SUCH ADVERTISING.

8. PLEASE STATE THE LEVELS OF FLEET FUEL ECONOMY, FOR BOTH PASSENGER AUTOMOBILES AND LIGHT TRUCKS, THAT YOU PROJECT WILL BE ACHIEVED BY YOUR COMPANY BETWEEN 1990 AND 2000 IF THERE IS NO CHANGE IN FEDERAL CAFE STANDARDS.

9. PLEASE STATE THE RANGE OF YOUR COMPANY'S ACHIEVABLE LEVELS OF NEW FLEET FUEL ECONOMY BY THE YEARS 1995 AND 2000, FOR BOTH PASSENGER AUTOMOBILES AND LIGHT TRUCKS, AND THE COSTS ASSOCIATED WITH ACHIEVEMENT OF EACH LEVEL. INCLUDE IN YOUR DISCUSSION THE LEVEL THAT WOULD BE ACHIEVED ASSUMING THE MAXIUMUM

POSSIBLE USE OF TECHNOLOGY THAT IS CURRENTLY IN PRODCUTION, AND ALSO ASSUMING NO PERFORMANCE LOSS OR MOVE TO SMALLER VEHICLES.

10. PLEASE PROVIDE YOUR VIEWS OF THE CURRENT STRUCTURE OF THE CAFE STANDARDS, AND ANY SUGGESTIONS YOU HAVE FOR IMPROVEMENT IN THAT STRUCTURE.

11. PLEASE PROVIDE THE AMOUNT, STATED IN DOLLARS AND IN PERCENTAGE OF SALES RECEIPTS, THAT YOUR COMPANY HAS SPENT ON RESEARCH AND DEVELOPMENT OF FUEL EFFICIENCY TECHNOLOGY IN EACH YEAR SINCE 1975.

12. PLEASE LIST ANY TECHNOLOGICAL IMPROVEMENTS RELATED TO IMPROVED FUEL ECONOMY THAT HAVE BEEN USED IN PRODUCTION OF VEHICLES IN THE LIGHT TRUCK CATEGORY SINCE 1980.

13. PLEASE STATE THE PERCENTAGE OF YOUR PASSENGER VEHICLE SALES THAT ARE ATTRIBUTABLE TO VEHICLES IN THE LIGHT TRUCK CATEGORY FOR EACH YEAR BETWEEN 1980 AND THE PRESENT.

14. PLEASE LIST THE FUEL ECONOMY STANDARDS ACHIEVED BY YOUR LIGHT TRUCK FLEET FOR EACH YEAR FROM 1978 TO THE PRESENT. PLEASE INCLUDE IN YOUR ANSWER YOUR OVERALL LIGHT TRUCK FLEET FUEL ECONOMY AVERAGE ADJUSTED FOR THE LEVEL OF SALES IN EACH LIGHT TRUCK CATEGORY (THE SALES-WEIGHTED AVERAGE ACROSS THE FLEET).

15. PLEASE STATE THE EFFECT OF INCREASES IN CAFE STANDARDS ON THE COMPETITIVENESS OF THE U.S. AUTO INDUSTRY AND THE U.S. JOB MARKET, ASSUMING PASSENGER CAR STANDARDS OF 34 MPG BY 1995, OR ASSUMING A 20% INCREASE IN EACH MANUFACTURERS' AVERAGE BY 1995.

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